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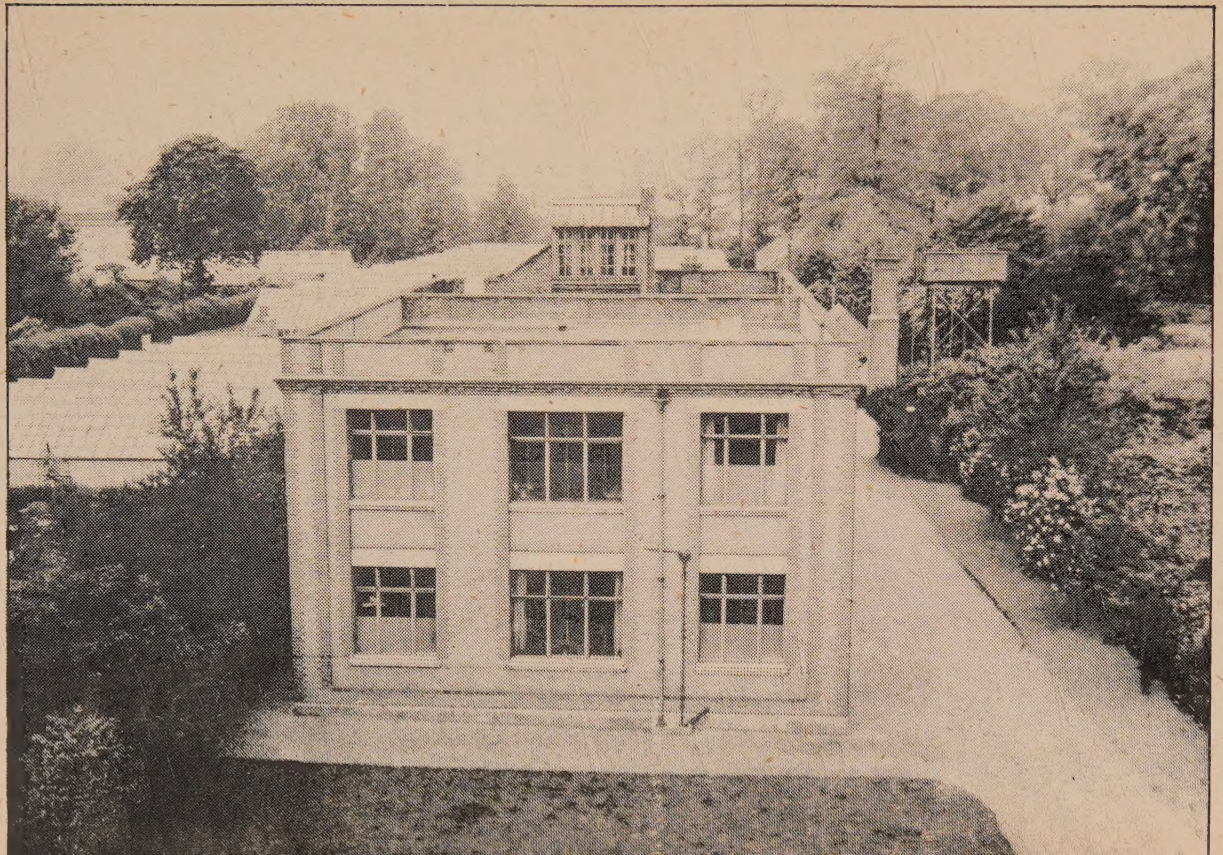

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Introduction.

THE splendid efforts of the glasshouse industry to fill the Nation's larder with an abundance of tomatoes and lettuce, have been maintained despite increasing shortage of labour, which has placed a severe strain on many nurseries. Those who are essentially specialists in flowers and other non-essential crops have learned to grow heavy crops of tomatoes and have added considerably to the total output. Steam sterilization of the soil is much more widely known and practised than ever before. The Ministry of Agriculture through the County War Agricultural Executive Committees has provided facilities for steam sterilization in areas where steam boilers were previously unavailable. The crop increases in many instances, have been spectacular and many growers who were prejudiced against steaming are now some of its most ardent supporters.

The work of the Cheshunt Research Station has extended considerably since the outbreak of war. Growers are depending more and more upon the advice of the research worker and our membership list has been increased by the addition of 406 new members since the beginning of 1940.

A third National Trial of outdoor tomatoes was organised with the help of county officers in different parts of the country. Sixteen English counties and three Welsh counties took part.

A second short course on commercial glasshouse work was organised for the five days commencing Monday, May 3rd. It was attended by 62 horticultural officers, an increase of 28 over the first course held the

previous year. Part of the time was allocated to our visitors, who submitted papers dealing with the most important problems of their particular counties. Many interesting discussions resulted.

The course was an unqualified success and at the request of those who attended it was decided to arrange a third course in 1944, at which addresses would be given by members of the Research Station staff as in 1942.

At the request of the Agricultural Research Council the Station is co-operating with Professor Todd, of Manchester University, in the preparation of a root exudate from the tomato.

Current Investigations.

The experiments started in 1940 to study the relative effects of muriate and sulphate of potash upon the tomato crop, have been continued on the same plots. The mean yields for the four years are 54.82 tons per acre from the sulphate and 52.63 tons per acre from the muriate of potash.

The muriate of potash has not produced any harmful effects on the foliage except during one short period in 1943, when the leaves became distinctly yellowish. This was the period of greatest strain, when the five bottom trusses had reached their maximum size and picking was just commencing. The plants recovered when most of the bottom crop had been picked. These investigations have shown that sulphate of potash may be replaced by the muriate for at least four years so far as the soil at the Station is concerned. It must be remembered, however, that harmful effects may be produced when the soil is sufficiently rich in chloride.

The application of horse manure and a base fertilizer mixture before and after steaming did not increase the yield of the four tomato varieties, Ailsa Craig, Cooper's Ideal, E.S.4, and Watson's Best of

All. The same applied to the balanced fertilizer mixture when dug into the soil either before or after steaming. Chopped straw, 12 tons per acre, depressed the yield slightly, when applied either before or after steaming. Tomato leaves and shoots, composted during the previous Summer, did not increase the yield when dug into the soil before steaming.

The effect of mixing flowers of sulphur with the soil after steaming, lowered the pH but did not affect the yield. Rates of application were 2 ozs. and 4 ozs. per square yard respectively. Sulphuric acid equivalent to 2 ozs. sulphur per square yard gave a similar effect.

Variety trials were continued as in the past. The high yields obtained from the F_1 generation of Stirling Castle x E.S. 1, and Stirling Castle x Up-to-date in 1942, were not repeated by the F_2 generation in 1943. It is assumed that the results in 1942 were due to hybrid vigour. The work will be repeated in 1944.

Seeds of two Russian tomato varieties Bizon and Stambovoi Alpatyev, reputed resistant to frost were obtained through the kind offices of the Ministry of Agriculture and the Russian authorities. These were distributed to certain County Officers and a few growers for trial. Unfortunately the seed arrived late and it was not possible to obtain much information on their ability to resist frost, although the Scottish trials suggested that neither were more resistant than varieties like Essex Wonder. Both varieties proved to be earlier than any of the English varieties except perhaps Jones' Outdoor Prolific, one of the so called potato leaf types. Unfavourable reports were received regarding Bizon owing to its irregular shape and general coarseness, but Stambovoi produced good fruit and is worth further investigation.

Tomatoes were grown for the fourth year in cucumber houses, using the roof crop method. An average of 38.94 tons per acre only was obtained, but this is attributable to a heavy root infection by the

root eelworm, *Heterodera marionii*. In the roof crop method three rows of plants are planted on either side of the central path, the two inner rows on each side being removed when the crop (four to five trusses) has been picked. A considerable increase in crop (56.33 tons per acre) in comparison with the control (39.26 tons per acre) was obtained when the two inner rows of plants on either side were replaced by twice the number of plants in " 32 " pots. These were merely stood out on the ground and stopped at two trusses. The method will be repeated in 1944 for it shows great promise.

Cheshunt Early Giant lettuce in heated glasshouses and Cheshunt Early Ball in cold houses and in frames have both maintained their excellence. Many excellent crops are grown annually on nurseries all over the country. The new hybrids 5a and 5b are being tried commercially and have already won some growers approval. They are particularly suitable for steam sterilized soil and for rich land. They mature 10-14 days earlier than Cheshunt Early Giant.

The work on *Verticillium* wilt has been continued. The differential effects produced in 1942 by *V. albo-atrum* and *V. dahliae* on the varieties Ailsa Craig and Riverside were not confirmed. It would appear that cultural conditions must be standardised as far as possible before the method of seedling inoculation can be depended upon to give consistent results. Further observations have been made on the growth of the two fungi in pure culture.

A stem rot of the tomato caused by *Phytophthora parasitica* was observed for the first time. The lesions occurred at a height of one to four feet above soil level. The presence of the same fungus in mummified fruit on the bottom truss was also established.

Experiments were made to see if the addition of peat to seed-sowing composts affected the damping-off of tomato seedlings by *Phytophthora* spp. Consistent

results were not obtained and it is assumed that the effect of peat on the incidence of damping-off, varies with soil type and prevailing conditions.

Further experiments were carried out in an attempt to determine the cause of a fruit blemish of Devon Surprise types of tomato, which occurs on plants grown in the open, but without success.

Work on *Didymella* stem rot of tomato was continued. The fungus proved resistent to low temperatures and cultures over-wintered out-of-doors were more virulent than similar cultures kept at room temperature. *Didymella lycopersici* was grown on a wide range of organic materials in pure culture.

A satisfactory control of this disease has not been found but promising results have been obtained by the use of mixtures containing salicylanilide for protecting the stem of the plants from attack, especially from attack at soil level. A number of fungicides showing promise in laboratory tests failed when tested on growing plants and several increased their susceptibility to infection.

The possibility of growing tomato plants infected with Spotted Wilt virus through the severe phases of the disease, was investigated. Results were remarkable for the diversity of symptoms, both primary and secondary, produced on plants receiving similar manurial treatments. It was shown that plants inoculated with the Spotted Wilt virus only, and developing typical symptoms of this virus, may later become infected with tomato mosaic virus very easily, producing a further range of " mixed " symptoms in which those of mosaic virus tends to predominate.

The value of stable manure in reducing the incidence of mosaic-induced blotchy ripening was confirmed in 1943. The inclusion of 25% peat for pot work markedly increased the percentage of fruits showing virus-induced blotchy ripening.

The application of top-dressings containing nitrogen and phosphoric acid during early stages in the growth of tomato plants did not prevent severe infestations by red-spider mite from developing at a later date.

Observations upon the distribution of plants severely and slightly infested by the mite in tomato houses suggest that severity of attack may be in some way correlated with rate of evaporation from the soil surface.

Application of thymol solutions to soil infested with Root-knot eelworm gave variable and inconsistent results in preventing tomato plants from becoming infested.

Results of previous observations upon the destruction of lettuce by wireworms have been confirmed: considerable reduction in the number of plants attacked was recorded soon after wheat, used as a bait, germinated, as compared with a control in which no bait of wheat was employed.

The examination of a series of tar acid fractions of different boiling point ranges has been continued. *Didymella lycopersici* has been used as the test fungus in evaluating their fungicidal properties in the presence of soil. Preliminary results with this fungus indicate that in the presence of the soil used, the fungicidal values of the tar acid fractions remain almost constant until a boiling point exceeding 25°0C. is reached. The fungicidal value in the soil gradually decreases with increasing boiling point above this limit. The toxicity of the tar acids to plants growing in soil decreases as the boiling point of the fraction increases.

The outdoor tomato plants on which trials of fungicides for the control of "blight" (*Phytophthora infestans*) were being made, did not contract this disease. Attempts to infect them by spraying with suspensions of spores of *P. infestans* were unsuccessful.

Work is proceeding on the elaboration of a method for determining formaldehyde and paraformaldehyde in soils.

Periodic determinations of chloride concentration in the soil of plots used for comparing the continued use of muriate and sulphate of potash show that between January and June the values may run up to 0.14% of sodium chloride, one peak value of 0.18% being recorded. After June values for chloride are lower but are always higher in the muriate than in the sulphate plots. At the end of the season the plots were steamed and the very heavy flooding which followed reduced chlorides to a negligible quantity.

The work on the trace elements has been continued, and under the conditions of the experiments, the omission of boron or magnesium has early and pronounced effects on growth. It appears probable that the effects, particularly that of boron, are operative sometime before pronounced signs of injury become apparent. In the case of boron it has been found that when definite symptoms of deficiency are established addition of boron to the medium was without effect.

Experiments on the effects of sulphur and an equivalent amount of sulphuric acid on soil reaction have been started. At the end of the year a reduction in pH is recorded but there has been no significant effect on yields. This may be due to the application of insufficient sulphur as the pH values are still above 7.

Wood ashes as a source of potash for tomatoes as already recommended in early reports have been used without ill-effect on Cheshunt Early Giant lettuce.

DIRECTOR'S REPORT.

1. Experimental Results of 1943.

1. Tomatoes.

The practice of grading the tomato fruits from the experimental plots, adopted in 1921, was continued :—

A.—" Pinks " number 5 to 7 and " Pink and White " 8 to 10 to the lb. These are the best quality of fruit in size, shape and colour ; " Pinks " being slightly larger than " Pink and Whites."

B.—" Whites." These fruits are of good colour but smaller than " Pink and White."

C.—" Blues." This grade consists of fruits of good colour but larger and more irregular in shape than Grade A.

D.—" Roughs." Small mis-shapen fruits about the size of cherries.

E.—Blotchy fruits which ripen irregularly.

F.—Fruits showing Blossom End Rot.

G.—Fruits showing the lesions of Streak Disease.

H.—Fruits showing " Green Back."

(a) Houses 7-9. Sulphate of potash versus muriate of potash.

At the commencement of the War a possible future shortage of sulphate of potash was visualised, and therefore in 1940 arrangements were made to compare the relative effects of sulphate and muriate of potash year by year in the same plots. Houses 7-9 were allocated for this purpose, 7 and 8 being planted with the variety Potentate and 9 with E.S.1. Each house was divided in four equal plots. Two of these received the normal manurial treatment, and in the others the sulphate of potash was replaced by the equivalent amount of muriate of potash. The normal treatment is as follows :—

1.—Applied before planting.

Hoof and horn	10 cwts.	per acre.
Bone meal	10 ,,	
Sulphate of potash	10 ,,	

2.—Top dressing.

(*a*) Sulphate of potash 5 cwts. per acre.

(*b*) A top-dressing mixture containing 10% potash as sulphate of potash totalling 20 to 30 cwts. per acre as required.

Table 1.

Sulphate of potash versus muriate of potash. Fourth Year.

House	Plot	Treatment	Crop yield in lbs. per plant						Total tons per acre	Average tons per acre	% blotchy ripening	
			May	June	July	Aug.	Sept.	Total				
7	1	Sulphate of potash	0.53	1.96	1.82	0.86	1.02	6.19	47.05		5.33	
	3	,, ,,	0.20	2.34	1.59	0.84	1.19	6.16	46.81		3.08	
8	2	,, ,,	0.18	2.65	1.67	1.20	1.25	6.95	52.82	51.02	4.17	3.08
	4	,, ,,	0.11	2.41	2.21	0.91	1.55	7.19	54.64		5.18	
9	1	,, ,,	0.11	1.68	1.88	1.72	1.25	6.64	50.47		0.45	
	3	,, ,,	——	1.42	2.34	1.98	1.41	7.15	54.32		0.28	
7	2	Muriate of potash	0.40	2.04	1.76	0.93	1.30	6.43	48.87		4.82	
	4	,, ,,	0.26	2.32	1.96	0.99	1.05	6.58	50.02		4.11	
8	1	,, ,,	0.26	2.34	1.79	1.17	1.43	6.99	53.12	50.20	3.44	2.75
	3	,, ,,	0.05	2.39	1.60	0.93	1.25	6.22	47.26		3.11	
9	2	,, ,,	0.03	1.69	1.87	1.77	1.17	6.53	49.63		0.46	
	4	,, ,,	0.03	1.40	2.16	1.93	1.23	6.75	51.29		0.50	

Varieties : Potentate in houses 7 and 8, E.S.1. in house 9.

The experiment has now been in progress four years, without yielding any startling results. The crop yields for 1943 are given in Table 1.

The results show that even after four years' application on the same soil there is little difference in yield between the plots receiving the sulphate and those receiving the muriate of potash. It was observed,however, that about the time picking commenced and therefore when the full strain of five heavy trusses of fruit was being borne by the plants that the foliage, particularly in the case of Potentate had assumed a light yellowish green colour. Soil analysis in respect of chloride showed that the chloride values were at a maximum about May 1st. By June 2nd the values had fallen considerably and from the end of July the plants had recovered their normal tint. Further details are given in Dr. Owen's report in the Chemical Section.

It seems safe to assume that the yellow discoloration of the foliage was associated with the high chloride content of the soil and that recovery followed a reduction in chloride content resulting from the application of water in the ordinary cultivation routine. It is interesting to note further that after steam sterilisation at the end of the season and the very heavy flooding which followed, the chloride content of the soil was reduced to a low value, and there was little difference between plots treated with either sulphate or muriate of potash.

(b) Houses 1, 2 and 3. Manurial treatment of steam-sterilized soil.

As the soil in these houses has grown tomatoes for 30 years, it was thought that the application of either horse manure or straw might increase the crop. So plots were arranged in which these materials were applied either before or after steaming. Base fertilisers were examined similarly.

The results are given in Table 2.

Straw. The application of 12 tons of wheat straw, chopped in two-inch lengths checked the growth of the plants and caused a very definite hardening. Recovery, however, was induced rapidly by two applications of either sulphate of ammonia or dried blood, each at the rate of one ounce per square yard. Of the two dried blood was the more satisfactory and produced the desired results more quickly. The total yield from these plots was slightly lower than from the controls which received sulphate of potash only. It did not seem to matter whether the straw was applied before or after steaming.

Table 2.

House	Plot	Variety	Treatment before planting	Crop yield in lbs. per plant							Total tons per acre	Average tons per acre	% Blotchy ripening
				May	June	July	Aug.	Sept.	Oct.	Total			
1	1	E.S.4.	Control: Sulphate of potash after steaming	0.03	1.58	2.75	1.48	0.83	0.31	6.98	53.05	48.66	0.28
	2	Ailsa Craig	,, ,, ,, ,,	—	1.41	3.04	1.36	0.52	0.24	6.57	49.93		0.60
	3	Watson's Best of All..	,, ,, ,, ,,	—	0.90	3.06	1.34	0.46	0.20	5.96	45.29		1.34
	4	Cooper's Ideal ..	,, ,, ,, ,,	—	1.15	3.08	1.22	0.46	0.19	6.10	46.36		0.49
1	5	Ailsa Craig	Stable manure: 30 tons per acre; Hoof and horn: 10 cwts. per acre; Bone meal: 10 cwts. per acre; Sulphate of potash 10 cwts. per acre *All* before steaming ..	—	1.23	3.03	1.53	0.37	0.15	6.31	47.95	42.69	0.63
	6	Watson's Best of All..	,, ,, ,, ,,	—	0.79	3.07	1.99	0.37	0.16	6.38	48.49		0.30
	7	Cooper's Ideal ..	,, ,, ,, ,,	—	0.96	2.49	1.33	0.25	0.11	5.14	39.06		1.95
	8	E.S.4.	,, ,, ,, ,,	—	0.82	2.09	1.44	0.22	0.07	4.64	35.26		0.62
1	9	Cooper's Ideal ..	As plots 5-8, but after steaming	—	0.80	2.40	1.85	0.34	0.13	5.52	41.95	41.36	1.26
	10	Watson's Best of All ..	,, ,, ,, ,,	—	0.72	2.18	1.56	0.30	0.13	4.89	37.16		—
	11	Ailsa Craig	,, ,, ,, ,,	—	1.18	2.37	1.70	0.23	0.14	5.62	42.71		0.35
	12	E.S.4.	,, ,, ,, ,,	—	0.92	2.46	2.03	0.21	0.12	5.74	43.62		0.34
1	13	Watson's Best of All ..	As Plots 5-8, before steaming	—	0.94	2.48	1.94	0.29	0.22	5.87	44.61	45.39	0.33
	14	Ailsa Craig	,, ,, ,, ,,	—	1.21	2.35	1.41	0.22	0.14	5.33	40.51		0.20
	15	E.S.4.	,, ,, ,, ,,	—	1.24	2.56	1.81	0.47	0.23	6.31	47.96		—
	16	Cooper's Ideal ..	,, ,, ,, ,,	—	1.40	2.72	1.66	0.39	0.21	6.38	48.49		0.14

Continued overleaf

Table 2 (*continued*).

House	Plot	Variety	Treatment before planting	Crop yield in lbs. per plant							Total tons per acre	Average tons per acre	% Blotchy ripening
				May	June	July	Aug.	Sept.	Oct.	Total			
2	1	Cooper's Ideal	Complete artificials after steaming	0.02	1.28	2.24	1.14	0.57	0.31	5.56	42.26		0.54
	2	Ailsa Craig	,, ,, ,, ,,	—	1.38	2.52	1.34	0.53	0.28	6.05	45.98	43.23	0.33
	3	E.S.4.	,, ,, ,, ,,	—	1.18	2.25	1.30	0.45	0.24	5.42	41.19		0.73
	4	Watson's Best of All ..	,, ,, ,, ,,	—	0.73	2.28	1.60	0.56	0.55	5.72	43.47		0.16
2	5	E.S.4.	Control: potash only after steaming	—	0.99	2.21	1.50	0.46	0.31	5.47	41.57		0.36
	6	Ailsa Craig	,, ,, ,, ,,	—	1.02	2.40	1.39	0.46	0.26	5.53	42.03	40.74	0.90
	7	Cooper's Ideal ..	,, ,, ,, ,,	—	0.93	1.92	1.48	0.33	0.30	4.96	37.70		1.61
	8	Watson's Best of All ..	,, ,, ,, ,,	—	0.88	1.89	1.68	0.42	0.61	5.48	41.65		1.55
2	9	E.S.4.	Chopped Straw: 12 tons per acre after steaming ..	—	0.86	1.90	1.54	0.43	0.26	4.99	37.92		0.79
	10	Cooper's Ideal ..	,, ,, ,, ,,	—	1.05	2.13	1.32	0.30	0.17	4.97	37.77	38.49	1.61
	11	Watson's Best of All ..	,, ,, ,, ,,	—	0.83	1.85	1.52	0.40	0.28	4.88	37.09		0.19
	12	Ailsa Craig	,, ,, ,, ,,	—	1.28	2.14	1.44	0.32	0.24	5.42	41.19		0.36
2	13	E.S.4.	Complete artificials before steaming	—	1.25	2.35	1.31	0.27	0.23	5.41	41.12		0.73
	14	Ailsa Craig	,, ,, ,, ,,	—	1.43	2.46	1.10	0.37	0.27	5.63	42.56	40.97	0.70
	15	Watson's Best of All ..	,, ,, ,, ,,	—	0.95	2.35	1.25	0.42	0.30	5.27	40.05		0.17
	16	Cooper's Ideal ..	,, ,, ,, ,,	0.02	1.39	2.07	1.22	0.32	0.26	5.28	40.13		1.13

Table 2 (*continued*).

3	1	E.S.4.	Chopped straw: 12 tons per acre after steaming ..	0.08	1.58	2.33	1.18	0.44	0.27	5.88	44.69		0.34
	2	Watson's Best of All ..	„ „ „ „	0.07	1.20	2.39	0.92	0.44	0.40	5.42	41.19	42.62	0.92
	3	Cooper's Ideal ..	„ „ „ „	0.03	1.17	2.32	0.93	0.40	0.15	5.00	38.00		1.20
	4	Ailsa Craig	„ „ „ „	0.06	1.48	2.53	1.20	0.59	0.27	6.13	46.59		0.66
3	5	Watson's Best of All ..	Chopped straw: 12 tons per acre before steaming ..	0.02	1.08	1.99	0.94	0.46	0.45	4.94	37.54		0.40
	6	E.S.4.	„ „ „ „	0.02	1.44	2.25	0.91	0.38	0.20	5.20	39.51	39.13	0.38
	7	Ailsa Craig	„ „ „ „	0.01	1.57	2.21	0.80	0.35	0.17	5.11	38.81		0.39
	8	Cooper's Ideal ..	„ „ „ „	0.01	1.32	2.53	0.83	0.44	0.22	5.35	40.66		1.13
3	9	Ailsa Craig	Control: No straw	—	1.63	2.41	1.22	0.57	0.25	6.08	46.19		0.66
	10	E.S.4.	„ „	—	2.06	2.62	1.12	0.37	0.11	6.28	47.73	45.86	0.48
	11	Watson's Best of All ..	„ „	0.01	1.22	2.23	1.27	0.62	0.33	5.68	43.17		0.35
	12	Cooper's Ideal ..	„ „	0.02	1.64	2.55	1.31	0.40	0.18	6.10	46.36		—
3	13	E.S.4.	As plots 5-8	0.02	1.72	2.42	1.04	0.37	0.19	5.76	43.77		0.70
	14	Watson's Best of All ..	„ „	0.01	1.16	2.51	1.17	0.52	0.26	5.63	41.95	40.81	0.72
	15	Cooper's Ideal ..	„ „	0.01	1.64	1.75	0.70	0.30	0.08	4.48	34.05		0.45
	16	Ailsa Craig	„ „	0.10	1.87	1.89	1.27	0.37	0.02	5.52	43.47		0.53

Horse manure and base fertilisers.

The application of horse manure 30 tons per acre and or a complete base fertiliser mixture applied either before or after steaming was also without effect, for the crop yields only differed slightly from those of the control plots which received sulphate of potash only.

(c) Composted tomato leaves.

During the previous season 1942, all the young leaves, shoots, etc., were collected day by day and composted in a heap with sulphate of ammonia and lime. Fermentation proceeded satisfactorily and the result was a large quantity of dark material resembling leaf mould. In 1943 two plots in house 5 were treated with this compost at the rate of 15 tons per acre. Two other plots received horse manure at the same rate. Afterwards the soil was steamed. The resulting crop (Table 3) was slightly in favour of the horse manure, being 57.08 tons per acre from the manure and 54.37 from the compost.

(d) Sulphur and sulphuric acid.

Three plots in house 5 were used for an experiment in which an attempt was made to lower the pH of the soil either by adding flowers of sulphur or sulphuric acid. Plot 4 received flowers of sulphur 2 ozs. per square yard, and plot 6 twice this amount. In plot 5 was added dilute sulphuric acid equivalent to 2 ozs. flowers of sulphur per square yard.

A further account of the effect of these treatments is described by Dr. Owen in the Chemical Section of this Report.

All three treatments had the effect of reducing the pH, sulphuric acid being the most effective, but as will be seen from Table 3, the effect on the crop was very slight.

(e) Tomatoes in cucumber houses.

The trials in the cucumber houses consisted of varying the number and arrangement of the plants in each house.

The standard method of planting, allows for three rows of plants on either side of the centre path, the four middle rows of the house being removed as soon as the crop from four or five trusses has been picked. In these experiments, some plots consisted of only one row on either side of the house, others had two rows and the control plots three rows. Some plants were planted in shallow trenches, some in ridges. The results given in Table 4 show that none of these methods gave as high a yield as the controls.

An interesting experiment was carried out in plots G1 and G6. Here plants in size 32 pots were stood on the border in front of the back row, which was planted in the border in the normal way.

Variety : Potentate. **Table 3.** **Soil steam sterilised**

House	Plot	Treatment	Crop weight in lbs. per plant							Total tons per acre	Average tons per acre	% blotchy ripening
			May	June	July	Aug.	Sept.	Oct.	Total			
5	1	Control	0.35	2.26	2.58	1.34	0.47	0.18	7.18	54.57	57.08	8.35
	7	Control	0.23	2.15	3.19	1.51	0.60	0.16	7.84	59.58		10.34
	2	Composted tomato leaves dug in before steaming	0.27	2.46	2.60	1.11	0.49	0.18	7.11	54.03	54.37	5.47
	8	Composted tomato leaves dug in before steaming	0.14	2.39	2.84	1.28	0.51	0.14	7.30	54.71		6.95
5	3	Control	0.22	2.25	2.70	1.30	0.67	0.26	7.40	56.24		6.62
	4	Flowers of Sulphur : 2 ozs. per square yard	0.20	2.48	2.61	1.42	0.47	0.24	7.42	56.40		4.44
		Flowers of Sulphur : 4 ozs. per square yard	0.16	1.91	3.15	1.48	0.71	0.26	7.67	58.28		5.45
	5	Sulphuric acid equivalent to sulphur applied in plot 4 ..	0.06	1.95	3.25	1.38	0.64	0.19	7.47	56.78		5.09
4	1	Complete artificials without nitrogen	0.42	2.20	1.73	1.36	0.77	0.26	6.74	51.22		6.22
	2	Unmanured	0.20	2.19	0.80	0.62	0.24	0.13	4.18	31.77		32.28
	10	Complete artificials without potash	0.46	2.10	1.44	1.13	0.85	0.25	6.23	47.35		24.88
	9	Complete artificials without phosphate	0.43	2.37	1.95	1.25	0.73	0.31	7.04	53.50		7.38
	3	Complete artificials	0.24	2.15	2.30	1.46	0.71	0.30	7.16	54.41		8.93
	8	Complete artificials with dung ..	0.36	2.46	2.24	1.35	0.79	0.39	7.59	57.66		8.59
	5	No lime : no base fertilisers. Minimum top dressings applied as necessary	0.18	2.33	2.49	1.32	0.61	0.30	7.23	54.93		10.24
	6	No lime : standard fertilisers ..	0.24	2.43	2.37	1.01	0.31	0.12	6.48	49.24		6.64
	4	Control	0.25	2.24	2.31	1.40	0.62	0.41	7.23	54.93	56.95	7.88
	7	Control	0.34	2.71	2.67	1.21	0.58	0.25	7.76	58.97		8.65

Table 4.

Tomatoes in Cucumber houses.

Variety: Potentate.

House	Treatment	Crop yield in tons per acre.						Total
		May	June	July	Aug.	Sept.	Oct.	
D 1	Control: Normal planting 3 rows of plants on either side of the path	0.89	10.36	9.20	4.02	5.31	4.73	34.51
D 2	One Row of plants only ...	0.48	4.76	8.71	8.40	4.81	2.78	29.94
E 1	Two rows of plants	0.77	9.28	12.00	5.99	3.73	5.43	37.20
E 2	,, ,, ,, ...	0.87	9.33	11.90	8.60	2.79	2.29	35.78
F 1	One row of plants on prepared raised beds	0.99	6.42	9.36	6.06	6.42	4.50	33.75
F 2	One row in a trench	0.60	6.27	9.51	6.87	6.09	4.50	33.84
F 3	,, ,, ,, ...	0.48	6.12	8.94	6.60	5.10	2.10	29.34
F 4	One row of plants	0.48	3.36	10.89	6.60	2.73	1.17	25.23
F 5	One row on raised bed ...	0.57	7.50	10.95	6.00	3.30	3.84	32.16
F 6	Control: 3 rows	0.30	11.25	13.89	5.67	3.00	3.57	37.68
G 1	One row of plants with plants in 32 pots stood in front ...	8.67	19.92	9.18	4.08	6.63	2.70	51.18
G 2	Control 3 rows	2.97	12.57	8.88	3.42	5.49	6.00	39.33
G 3	,, ,, ...	2.10	12.21	9.06	6.36	5.01	7.74	42.48
G 4	,, ,, ...	1.86	11.10	8.40	3.78	4.20	6.60	35.94
G 5	,, ,, ...	2.52	11.85	9.36	2.76	5.40	5.40	37.29
G 6	One row of plants with plants in 32 pots stood in front as in G1	7.41	23.85	13.80	6.15	6.57	3.69	61.47

These plants were staked and stopped at two trusses. As there were twice the number of plants that there would have been if they had been planted in the borders, the yield was the equivalent of four trusses per plant on the normal number of plants. As soon as the crop from these pot plants had been picked, they were removed from the house. As will be seen from Table 4, the total yield from these houses was 51 and 61 tons per acre respectively, which is a considerable increase. The experiment will be continued in 1944.

(f) Variety Trials.

The variety trials were carried out in the Rose House, which was turned over to tomatoes in 1941. The yields generally were high. As will be seen from Table 5 three varieties produced fruit free from blotchy ripening namely Manx Marvel, B.R.I., and L.M.R. 1. The highest yield came from Manx Marvel, followed by Ideal, Potentate and Bide's Recruit. It should be remembered, however, that Manx Marvel is one of the latest varieties in ripening.

TABLE 5.

Variety Trials.

Variety	*Crop weight in tons per acre*	*Percentage blotchy fruit*
Manx Marvel	75.08	——
Ideal	73.26	1.92
Potentate	72.96	3.18
Bide's Recruit	71.97	0.25
Kondine Red (Danish)	69.69	0.79
Humble Smith	69.24	0.52
Carrick	68.22	1.55
B.R.I.	66.88	——
Stirling Castle x Up-to-date F2 ...	66.12	8.60
Johnson's " Graday "	64.22	0.64
Blackdown Gem.	63.92	3.39
Comet	56.54	0.78
Poultonian	56.54	6.61
L.M.R. No. 1	55.33	——
Orange Sunrise	44.66	0.07

(g) Outdoor tomatoes.

Three new varieties for outdoor work, were imported through the Ministry of Agriculture, namely Stambovoi Alpatyev and Bizon from Russia, and Victor from the United States of America.

Stambovoi possesses a neat attractive dwarf habit, with deep green foliage, the leaves being small and thicker in texture than most of the dwarf types. The fruit is of medium size, deep scarlet

in colour and sweet to taste. Bizon is also a dwarf type, but its growth is not attractive. It possesses a small rambling truss, consisting usually of one large and two or three small corrugated greenish red fruit. The flavour is sweet but not so sweet as that of Stambovoi. Both Stambovoi and Bizon are early maturing varieties, the latter being earlier than the former.

Victor is an unusual type for under normal conditions it produces two trusses of fruit and then " stops " itself. It produces a few side shoots which should be retained because the foliage is sparse. The fruit is large, heavy and very fleshy : colour is a light scarlet and the flavour excellent.

Both Stambovoi and Bizon are reputed to be resistant to frost. The seeds arrived too late to test this resistance except in Scotland, but the reports suggest that actually they are not more resistant than many of the ordinary English varieties.

The observations of those who tested these varieties indicate the following preliminary conclusions :—

(*a*) Stambovoi and Bizon are more resistant to adverse conditions such as low temperatures, and strong winds at the time of planting out than the average English varieties.

(*b*) Neither are resistant to frost exceeding two or three degrees.

(*c*) At the end of the season the plants, flowers and fruit are injured as much by frost as the usual varieties.

(*d*) Bizon is a coarse type, yielding badly-shaped fruit.

(*e*) Stambovoi Alpatyev has an attractive habit and produces good shaped fruit.

(*f*) Both varieties mature earlier than the English varieties, in some cases to the extent of three weeks.

(*g*) Stambovoi has definite commercial possibilities and is worth further trial.

(h) National Trials of outdoor tomatoes.

The third of the series of National Trials was organised with the co-operation of county staffs at 16 centres in England and 3 in Wales. Labour difficulties prevented other counties from taking part in these trials.

Training experiment.

The training experiment was arranged as a Latin Square of 16 plots covering the following treatments :—

(*a*) Double rows of plants, 3 feet apart, allowing 18 inches between the two rows, and spacing the plants 18 inches apart in the rows. 140 plants per plot, 30 feet by 15 feet.

(*b*) Single rows of plants, 3 feet apart, the plants being spaced 18 inches apart in the rows, 100 plants per plot.

In both (*a*) and (*b*) the plants were trained as single stems.

(*c*) Plants 24 inches apart in rows 3 feet apart. The plants were trained as two stems by allowing the strongest of the shoots arising below the bottom truss to form the second stem. 80 plants per plot.

(*d*) Plants 36 inches apart in rows 3 feet apart, the plants being trained on those stems. 50 plants per plot.

The results obtained were similar in most cases. The heaviest weight of fruit ripened on the plants came from the double rows of plants trained as single stems, but the heaviest total crop, was produced by either the two-stemmed or three-stemmed plants. The increased crop, however, did not compensate for the labour involved, and therefore the best planting arrangement for commercial work is the double row system.

Most counties carried out simple variety trials, but no outstanding new varieties have been reported. Stoner's varieties held their own so far as weight of crop was concerned. Harbinger has also done well in several counties.

2. Lettuce.

Cheshunt Early Giant lettuce for heated glasshouses and Cheshunt Early Ball for cold houses and frames are being grown extensively during the autumn and winter and are contributing handsomely to the war effort. The new varieties 5a and 5b are being tested commercially. Reports upon the behaviour of the last two varieties would be appreciated as a guide to their usefulness for future work. At the Research Station they have proved slightly earlier in maturing than Cheshunt Early Giant, and also more suitable for sterilised soil. Unfortunately the supply of seed will be be very small until the end of the war.

2. Mycological Report.

P. H. WILLIAMS.

1. General.

During the past year advisory work has shown a noteworthy increase. The figures of specimens received for the three years 1941-3 given below do not include virus diseases.

	1941	1942	1943
Tomatoes ...	270	295	436
Other crops ...	59	71	57
Total ...	329	366	493

The increase is nearly 50% on the 1942 figures and it may be noted that of the tomato plants sent in for examination 286 batches or about 68% were received during the four months May to August inclusive. Growers can do much to help in dealing with specimens expeditiously by seeing that they are packed in damp moss or grass so that they arrive in a fresh condition. Seedlings and leaves should on no account be enclosed in letters. A covering letter should be sent giving full particulars of the extent of the disease, and of the manurial and other treatments the plants have received. Such information is of great assistance in framing a suitable reply. If the letter be sent separately, a copy should, if possible, be enclosed with the specimen, and, in any case, a card giving the name of the grower should be included.

Of parasitic fungi attacking tomatoes, the most frequently recorded during the three years 1941-3 were species of *Phytophthora*. It is interesting to note that in each year the peak period of attack by these fungi came in May and June, *Phytophthora cryptogea* attacking the tap root and roots while *P. parasitica* infected the fruit also. It is probable that the majority of the cases of root-rot are legacies from damping-off and foot-rot in the propagating stages.

Stem rots due to *Didymella lycopersici* and *Botrytis cinerea* showed a marked increase during 1943 as also did *Verticillium* wilt. Increases in the number of specimens of such well-known diseases as Leaf Mould and Blossom-End Rot are doubtless due to the fact that many growers who have recently turned over to tomato growing from other crops are not familiar with these troubles. Other diseases and pests such as *Colletotrichum* root-rot and Root Knot (caused by eelworms) showed seasonal fluctuations throughout the three years.

2. Verticillium Wilt.

P. H. WILLIAMS.

In the 28th Annual Report for 1942, an experiment was described in which two strains of *Verticillium* showed significant differences in their pathogenicity to Manx Marvel, Ailsa Craig and the American variety Riverside. It was suggested that one of these strains (V243) might belong to another species of *Verticillium*. *V. dahliae*. Accordingly pure culture experiments have been carried out with these strains and others isolated in 1942. In addition, the infection experiments have been continued using single spore cultures from the strains used in 1942 and others isolated later.

Pure culture experiments.

The strains of *Verticillium* used were as follows :—

19. Reisolation from a tomato of a type culture of *V. dahliae* from the culture collection at Baarn, Holland.

24. Reisolation from tomato of V. 243.

25. Reisolation from tomato of a type culture of *V. albo-atrum* from Baarn.

30, 33, 34 and 36. Cultures isolated from tomato in 1942.

Cultures of each of these strains were made on autoclaved potato blocks. It was soon apparent that the cultures fell into two groups. In Group 1, consisting of strains 25, 30 and 33, the mycelium was at first white but later became dark owing to the production of carbonised hyphae and to the brown bases of the conidiophores. In the case of strain 25 the blackening was mainly confined to the region where the culture touched the glass. The carbonised hyphae were straight on the outside of the culture and swollen and twisted around one another in the tissue of the potato but did not form definite bodies.

In the second group, comprising strains 19, 24, 34 and 36, definite microsclerotia were formed. In 19 and 24 there was abundant aerial mycelium and microsclerotia were present in it as well as in a layer on the surface of the potato block. In 34 and 36, the microsclerotia formed a black, brittle crust on the surface of the medium with little or no aerial mycelium.

Sections were cut from pieces of potato tissue cultures in the case of strains 19, 25 and 30. These confirmed the observations made by teasing out portions of the culture. In strains 25 and 30, the fungus penetrated some way into the potato and consisted entirely of swollen hyphae sometimes twisted round one another. In strain 19 the fungus was more superficial. Some swollen and carbonised hyphae were present but it was apparent that the bulk of the blackening was due to the formation of definite microsclerotia.

Where these were cut across they showed a pseudo-parenchymatous structure quite distinct from the loosely twisted hyphae of the other group. This experiment was repeated using single spore cultures of strains 19, 24, 25, 30 and 34, cultures of *V. albo-atrum* and *V. dahliae* from Hop isolated by Dr. Keyworth and strain 56 isolated from tomato in 1943. The foregoing observations were entirely confirmed. Cultures of these strains on other media have also given the same results.

The formation of the resting bodies in these fungi was followed by means of hanging drop cultures on Dox's agar. Strains 24, 30 and 36 were used. In strain 30, belonging to group 1, only carbonised hyphae were formed. In strains 24 and 36, lengths of hyphae became divided into round, swollen hyaline cells which later budded to form masses of irregular shape. These masses later turned black to form the microsclerotia as seen in tube cultures. This experiment demonstrated that the black crust formed by strain 36 was composed of aggregates of microsclerotia similar to those formed by other strains of this group.

Observations made over a long period may be summed up as follows. In group 1 the aerial mycelium is short and compact and the darkening of the culture developes only after some lapse of time. In Group 2 on the contrary, the aerial mycelium is loose and cottony or almost absent and the blackening due to the development of microsclerotia starts almost at once. The ability to produce carbonised hyphae is lost more or less rapidly in Group 1 while cultures of fungi belonging to Group 2 continue to produce microsclerotia for much longer, in fact cultures of *Verticillium* isolated in 1937 still produce them abundantly.

Other differences between the groups were also noted. In Group 1 the conidiophores were dark brown at the base and the branches often bore secondary verticils. Again, when single spore cultures were being made, it was noted that the germ tubes of spores from fungi of Group 1 branched much more frequently than did those from Group 2 and therefore the resultant colony was more compact.

Comparison of the observations summarised above with the original descriptions of *V. albo-atrum* and *V. dahliae* and with the work of other investigators leaves no doubt that the fungi of Group 1 must be referred to *V. albo-atrum* and of Group 2 to *V. dahliae*.

Distribution of the fungi.

Two important considerations arise from the recognition that two species of *Verticillium* infect the tomato in this country, firstly, which is the most common and secondly, whether the present control measures will be equally efficacious with both fungi.

With regard to the first, an attempt has been made to identify as many cultures made from specimens submitted for examination as possible. So far fifteen strains have been isolated, eleven of *V. albo-atrum* and four of *V. dahliae*. The distribution of the fungi was as follows :—

	V. albo-atrum.	*V. dahliae.*
Bucks	0	1
Cumberland ...	1	0
Essex	3	2
Herts	5	0
Lancashire ...	1	0
Sussex	1	1

It will be noted that so far all cases of *V. dahliae* have come from the south of England, but it would be unwise to generalise from so few records.

Temperature requirements.

It has been stated by other workers that *V. dahliae* will grow at higher temperatures than *V. albo-atrum*. To investigate this point, several strains of both fungi have been grown on plates of Dox's agar at different temperatures. Owing to the breakdown of incubators and wartime difficulties with repairs, it has only been possible to carry out one full scale experiment but experiments covering the optimum and maximum temperatures of the fungi have been repeated several times. Table 1 shows the mean diameter in cms. of colonies of several strains of the fungi at varying temperatures.

Table 1.

Experiment	Strain	*Fungus*	15°C.	20°C.	25°C.	30°C.	35°C.
1	24	*V. dahliae* ...	2.8	3.4	3.9	2.4	0.0
	25	*V. albo-atrum* ...	3.1	3.3	3.4	0.6	0.0
2	19	*V. dahliae* ...	—	—	4.0	2.7	0.7
	24	*V. dahliae* ...	—	—	3.6	2.0	0.7
	34	*V. dahliae* ...	—	—	3.6	2.1	1.2
	36	*V. dahliae* ...	—	—	3.8	2.1	1.0
	25	*V. albo-atrum* ...	—	—	3.0	0.5	0.0
	30	*V. albo-atrum* ...	—	—	2.3	0.6	0.0
	33	*V. albo-atrum* ...	—	—	3.2	0.7	0.0
5	19	*V. dahliae* ...	—	—	4.9	2.5	0.0
	24	*V. dahliae* ...	—	—	4.2	1.0	0.0
	34	*V. dahliae* ...	—	—	4.2	2.1	0.0
	36	*V. dahliae* ...	—	—	4.6	2.2	0.0
	25	*V. albo-atrum* ...	—	—	3.4	0.2	0.0
	30	*V. albo-atrum* ...	—	—	3.6	0.4	0.0
	33	*V. albo-atrum* ...	—	—	4.4	0.1	0.0

In Experiment 2 the incubator at 35°C. failed and remained at 30°C. for several days allowing cultures of *V. dahliae* to develop somewhat. Otherwise neither fungus grew at this temperature. *V. dahliae* grew considerably better than *V. albo-atrum* at 30°C. and slightly better at 25°C. It would seem that the optimum temperature for the development of *V. albo-atrum* is about 25°C. (77°F.) and its maximum temperature slightly above 30°C. (86°F.). The optimum temperature for *V. dahliae* is between 25°C. and 30°C. while its maximum is above 30°C.

The effects of temperature on the disease when *V. dahliae* is the cause have not yet been studied. It appears likely that an average temperature of 77°F. as advised for the control of *V. albo-atrum* would have no effect on *V. dahliae* and might in fact favour the disease. It is therefore important that the exact identity of the fungus should be determined. This can be done easily if cultures are made from diseased plants, which have been packed to arrive in a fresh condition with stems free from soil.

Infection Experiments.

In the 28th Annual Report for 1942 an experiment was described in which the varieties Riverside and Manx Marvel were significantly more resistant to *V. albo-atrum* than was Ailsa Craig. All three varieties were attacked equally by V243, a strain of *Verticillium* now shown to be *V. dahliae*. If this result could be repeated, the method employed might prove useful for testing the resistance of tomato varieties to the two species of *Verticillium*.

In 1943, the experiments were simplified by only using Ailsa Craig and Riverside. The method of inoculation was the same as in the previous year but in each experiment the number of blocks was increased to six. The strains of the fungi used were single spore cultures and were as follows :—

Strain 41 from strain 24 *V. dahliae*.
„ 43 „ „ 25 *V. albo-atrum*.
„ 46 „ „ 30 *V. albo-atrum*.
„ 49 „ „ 34 *V. dahliae*.

In the first experiment the plants were examined five weeks after inoculation instead of four as in the previous year's experiments. The results are given in Table 2 which shows the mean number of dead and yellow leaves.

Table 2.

Variety	Control	41	43	46	49
Riverside ...	4.8	18.5	17.5	18.2	20.0
Ailsa Craig ...	8.8	18.5	19.3	22.2	22.2

Examination of these results showed that the difference between the controls was significant. The appropriate control figure was therefore subtracted from the figure obtained in each test and the results are shown in Table 3.

Table 3.

Variety	41	43	46	49
Riverside ...	13.6	12.6	13.3	15.2
Ailsa Craig ...	9.6	10.5	13.3	13.3

It was now found that only the variance due to the varieties was significant, Riverside being less resistant than Ailsa Craig.

The experiment was repeated, the plants being examined at the end of four weeks and again after five weeks.

The results are shown in Table 4.

Table 4.

Four weeks	Control	41	43	46	49
Riverside ...	1.8	11.2	8.5	10.8	13.0
Ailsa Craig ...	3.8	15.5	12.2	15.6	16.5
Five weeks					
Riverside ...	10.2	14.5	17.3	17.8	17.3
Ailsa Craig ...	11.6	19.0	18.3	22.0	21.5

In this experiment, the differences between the controls were not significant but it was obvious that cultural factors have produced effects very different from those of the previous experiment, for example Riverside was now significantly more resistant than Ailsa Craig. So far as it was possible to arrange, the conditions of the two experiments were identical and it has been concluded that some measure of control of such factors as temperature and humidity would be necessary before reliable results could be obtained by this method.

3. A Stem Rot of Tomato caused by *Didymella lycopersici*

Enid Sheard

The tomato stem rot caused by *Didymella lycopersici* became increasingly severe and widespread on glasshouse crops during 1943, particularly in the southern counties and the investigations begun in 1942 were continued.

Overwintering

To determine the effect of overwintering on the disease, pure cultures of the fungus on 3% fine oatmeal in sand to which 25% water had been added were held for a month at room temperature, after which time the fungus had become established on the medium. At the beginning of November half the cultures were placed in an open box out-of-doors and the other half kept in the laboratory. After five months a number of the cultures were used to inoculate steam sterilised soil and tomato plants were potted into it. The experiment was repeated two months later and the results are summarised in Table 1.

Table 1

	Experiment	Total No. of plants	No. infected	No. healthy
1.	Cultures out of doors ...	22	16	6
	Cultures at laboratory temperature ...	22	4	18
2.	Cultures out of doors ...	36	22	14
	Cultures at laboratory temperature ...	36	6	30

The results of these experiments indicate that the fungus is more virulent when it has overwintered out of doors than at temperatures averaging approximately 59°F.

Effect of age of the plant on the incidence of the disease

Tomato seeds were sown in sterilised soil to which sand/oatmeal cultures of *D. lycopersici* had been added. 97% of the seeds germinated and the seedlings were potted into 3 inch pots. After four weeks these plants were examined and none was found to be infected with *Didymella*. These results differ from those obtained from similar experiments the previous season in which 12% of the seedlings became infected and a number of seedlings which were apparently healthy when they were potted developed stem rot at a later stage.

Tomato seedlings from seeds germinated recently failed to become infected when sprayed with a spore suspension in water.

In a further experiment plants in size 32 pots bearing two trusses of fruit were inoculated at the same time as plants in 60 pots showing the first truss in flower. All the plants were kept under the same conditions. Fifteen out of twenty plants in 32's became infected while only three out of twenty-four plants in 60's developed stem rot. In addition, infection was more severe on the larger plants than on the smaller ones.

It is seen from these results that larger plants bearing trusses of fruit are more susceptible to the disease than plants in the propagating stages. In practice the disease rarely occurs until the plants are in the borders and carrying one or two trusses of fruit.

Seed transmission

A limited amount of infected seed was available in 1943 and this was sown in sterilised soil. Germination was poor (50%) and although some of the cotyledons emerged bearing the infected seed cases on their tips, none of the seedlings was infected. All the seedlings which germinated were potted into sterilised soil and examined after two months when none was found to be infected with *Didymella*. A number of these were transferred to larger pots and kept under observation for a further month at the end of which time all the plants were healthy.

It is thus possible to raise healthy plants from infected seed although such a practice is most inadvisable.

Other hosts

During the course of the year a number of plants were inoculated with *D. lycopersici* by atomising wounded and unwounded stems with spore suspensions in water and in some cases by introducing pure cultures of the fungus into the stems. In all cases tomato plants were inoculated at the same time as controls.

The only plant other than the tomato which was found to be readily susceptible to *Didymella* was the egg plant (*Solanum melongena*). Both wounded and unwounded plants developed stem rot and pycnidia were produced in large number on the lesions. Later, circular brown lesions developed on the leaves on which pycnidia were formed in concentric zones.

Wounded stems of black nightshade (*Solanum nigrum*) became infected and the plants died. Unwounded plants at first remained healthy but towards the end of the season they too developed stem rot.

Potato haulms inoculated at the beginning of July failed to become infected. When plants were inoculated in October, however, the haulms became infected and subsequently died. Wounded haulms were more susceptible than unwounded ones.

A slight infection was obtained on wounded stems of *Nicotiana glutinosa* and *N. tobaccum*. Undamaged plants remained healthy.

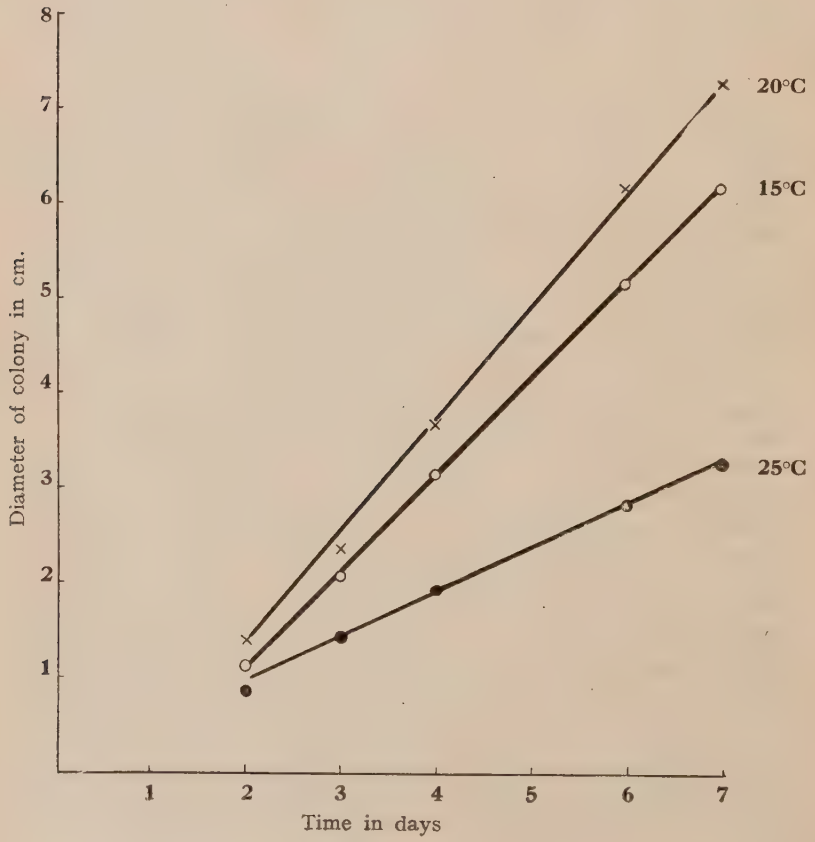
Saprophytic growth on organic materials

When the existence of *D. lycopersici* on plants other than tomato seemed unlikely, attention was turned to the possibility of the fungus living saprophytically on organic materials. A number of such materials were sterilised under pressure and inoculated with pure cultures of the fungus. *Didymella* was found to grow on a wide range of such substrata, producing mycelium and pycnidia often in large quantities. Good growth was obtained on hay, straw, and bread and also on potato, carrot and beetroot plugs. Medium growth occurred on raffia, rotten wood, and a leaf mould composed

of oak and holly leaves. Growth was less on new wood, oak and holly leaves which had recently fallen from the trees, cardboard, paper, cotton wool, leather and fillis. A very slight growth developed on hoof and horn and peat, and none at all on dried blood. In all cases growth was best when the substratum was relatively damp. These results indicate the possibility of *Didymella* existing saprophytically on a number of materials commonly found on nurseries.

When the uncooked roots of beetroot, carrot and parsnip, potato tubers and apple fruits were inoculated with *Didymella* a slight rot developed on the cut surfaces of beetroot, carrot and potato. The rotting of apple was more extensive, but in no case was a rot comparable to that of infected tomato fruit obtained.

Fig. 1. Rate of growth of *D. lycopersici* in pure culture



Temperature relations

Pure cultures of *D. lycopersici* on Czapek's agar were grown at different temperatures to determine the optimum temperature for growth. The temperatures used were 35°C., 30°C., 25°C., 20°C., and 15°C. No growth took place at 35°C. or 30°C. After seven days at these temperatures the cultures were transferred to 15°C. when all the cultures previously held at 30°C. grew normally. The cultures which had been kept at 35°C. for a week were dead. Owing to a failure of apparatus it was not possible to do any further work on this range of temperatures in 1943, but experiments carried out since indicate that *D. lycopersici* can survive shorter periods at 35°C. without being killed.

The results, shown in fig. 1, show that the optimum growth temperature for *Didymella* in pure culture is in the region of 20°C.

Pure cultures on agar slopes, spore suspensions in water and lengths of infected stems on the surfaces of which pycnidia were growing were exposed to low temperatures ranging from 0° to —10°C. for periods up to 1 hour. At the end of that time the spores suspensions etc., were allowed to thaw at room temperature and were used to inoculate tomato plants. In all cases the infection from the fungus exposed to low temperatures was equal to that from unfrozen controls.

It is concluded that *D. lycopersici* is resistant to the low temperatures to which it might be subjected out of doors in this country (—10°C. = 14°F.).

The investigations are being continued.

4. Experiments on the Control of Tomato Stem-rot (*Didymella lycopersici*) by chemical means.

W. H. Read.

Attacks of tomato " stem-rot " caused by the fungus *Didymella lycopersici* were widespread during the year on both glasshouse and outdoor tomatoes. The problem of finding a control is made difficult by the lack of definite knowledge regarding the source of this disease and the conditions under which tomato plants are most susceptible to attack.

In the majority of cases the plants have been attacked at the base of the stem, usually immediately above soil level but occasionally below soil level suggesting that the fungus was present either within or on the surface of the soil. The spores may

perhaps be carried into glasshouses by air currents and the attack take place at soil level because conditions there are most suitable for the development of the disease.

Where the fungus is present in the soil and gains entry into the plant below soil level the application of a protective fungicidal spray or dust is unlikely to prove as effective as treatment which will destroy the fungus in the soil. On the other hand if the spores of the fungus are carried by air currents a soil treatment would appear unlikely to effect control of the disease.

In view of the uncertainty regarding the way by which the plants are attacked, both the application of fungicidal drenches to the soil and the treatment of the bases of the stems of the plants with protective substances have been tried in an endeavour to find a method of controlling the disease.

The problem is further complicated by the apparent immunity of plants to attack under conditions not yet fully understood and many experiments have been repeated a number of times owing to the failure of the fungus to attack any of the plants both treated or untreated with the fungicide concerned.

Soil Sterilisation with Chemicals

Experiments made in 1942 showed that formaldehyde and tar acid sterilising fluids killed *Didymella* in laboratory trials and their action under conditions more like those encountered in the normal sterilisation of tomato borders was therefore investigated. The border soil in a small glasshouse was dug and manured in the normal manner and inoculated with *Didymella* by forking into it a sand-oatmeal culture of the fungus. One side of the house was untreated apart from being flooded with water. One half of the other side of the house was treated with a 1 in 50 solution of commercial 40% formaldehyde applied at the rate of 5 gallons to each square yard. The other half of this side was drenched with a proprietary emulsion containing 40% of tar acids of boiling range 210-240°C., using ten gallons of a 1 in 100 dilution per square yard. Apart from the sterilisation of two plots the three plots were given the same treatment and were planted up with tomatoes (var. Potentate) on March 16th. The plants in all plots were treated in the same manner and no special care was taken in removing the lower leaves and shoots. They were carefully examined every few days for signs of *Didymella* at the base of the stem. The only plants to become infected with the disease at the base of the stem were one in the untreated plot (June 7th) and one in the plot treated with the tar acid fluid (July 21st). Attacks of the disease higher up on the stems of the plants occurred late in the season (October) but it is unsafe to conlude that these infections were derived from the soil.

Unfortunately this experiment failed to show whether sterilisation of the soil with formaldehyde or a tar acid sterilising fluid gives control of *Didymella* attacks originating from an infected soil. The reason for the failure of the fungus to attack a higher proportion of the plants in the unserilised soil is not known but it is not without interest that similar cases have occurred on commercial nurseries where in spite of the absence of any system of soil sterilisation *Didymella* has not re-occurred although it was prevalent the previous year.

Soil treatments

Experiments were continued in an endeavour to find a fungicide or fungistatic substance which could be applied to the soil after planting and prevent the fungus from attacking the plants.

Tomato plants were planted up in a glasshouse in soil which had been heavily inoculated by incorporating a sand-oatmeal culture of *Didymella* in the top three inches of soil after manuring the soil with stable manure at the rate of 20 tons per acre and a base fertiliser at 15 cwts. per acre. Immediately after planting out twenty plants were watered with each of the following, Cheshunt compound at 1 oz. per gallon, Lime sulphur (27% w/v) polysulphide sulphur content 1 in 100, tar acid emulsion (40% phenols) 1 in 1,000. Applications of these solutions were given at weekly intervals except that after the fifth week the strength of the lime sulphur solution was reduced to 1 in 200. This experiment failed to yield any results since none of the control plants, watered in the normal way were attacked by *Didymella*.

A second experiment was conducted with pot plants. Tomatoes (variety Potentate) were transferred from size 60 pots into size 32 pots using a freshly steam-sterilised compost of five parts loam and one part well decayed horse manure to which a sand-oatmeal culture of *Didymella* was added after sterilising. One-third of these plants were watered immediately after potting and afterwards at weekly intervals with a 1 in 1,000 dilution of the tar acids emulsion, one third with a 1 in 1,000 solution of commercial 40% formaldehyde whilst the remainder served as control plants and received water only. Five weeks after potting several plants showed signs of *Didymella* and after ten weeks 85% of the control plants, 75% of those watered with the formaldehyde solution and 62% of those watered with the tar acid fluid were attacked by the disease. In all cases the diseased plants showed typical lesions on their stems at soil level. Although some reduction in the number of plants attacked resulted from watering with the tar acid fluid or formaldehyde solutions the degree of control obtained in both cases was very poor.

It is of interest to note the high proportion of plants which became attacked when potted into this compost or in which the culture of *Didymella* was added very soon after the soil had been sterilised by steaming.

Base of Stem Treatments

Concurrently with the experiments on soil treatments a number of tests were made to find if the attacks at the bases of the stems of tomatoes could be prevented by treating them with fungicidal or protective substances. In these experiments the bottom three inches of the stems were treated by painting or spraying with the substances after cutting off the leaves and side shoots and the bases of the stems sprayed 24 hours later with a suspension of spores of *Didymella* obtained from diseased tomato stems. Where the material was painted on the stem care was taken to ensure that every part of the stem down to the soil was covered. Rubber latex, vaseline, linseed and castor oils were each tried as mechanical barriers to see if they would prevent infection but they failed to do so. In one trial, control of the disease was obtained by painting the base of the stem with a suspension of 5% salicylanilide in a 1 in 5 dilution of a petroleum emulsion of the type used for controlling red spider, in further trials this treatment was practically without effect.

It has been claimed that painting the base of the stems of plants with creosote not only prevents attack but will also destroy the fungus in plants which are showing lesions due to *Didymella*. Several trials were made with creosote but the treated plants became attacked by the disease. Where lesions higher up the plants were painted with creosote the development of the disease was slightly retarded but the fungus ultimately grew out again beyond the painted area. When young plants at the planting out stage were painted with creosote at the base of their stems they were seriously injured by the treatment.

Much laboratory work has been undertaken in connection with the control of *Didymella*. As a result of laboratory tests salicylanilide, the active ingredient of the proprietary product "Shirlan," and tetramethyl thiuram disulphide were selected for further trials on growing plants.

The four bottom leaves and any accompanying side shoots on a number of tomatoes growing in size 32 pots were cut off with a knife. Two leaves on each plant being removed 24 hours before the plants were sprayed and two 2 hours before. The lower stems of one-third of the plants, were then sprayed with a proprietary suspension of salicylanilide* diluted to give 0.5% salicylanilide, another third with tetramethyl thiuram disulphide at 0.5%. Both spray fluids also contained a wetting agent. One third of the plants were unsprayed.

* Shirlan A.G.

Twenty-four hours after treatment the plants were inoculated with *Didymella* by spraying the lower portion of the stems with a suspension of spores. The number of trimming wounds out of a possible total of 24 which were infected four weeks later were :—

Unsprayed control plants

Wounds made	2	hours before spraying	...	7
,,	24	,, ,,	...	6

Plants sprayed with 0.5% salicylanilide

Wounds made	2	hours before spraying	...	2
,,	24	,, ,,	...	1

Plants sprayed with 0.5% tetramethyl thiuram disulphide

Wounds made	2	hours before spraying	...	12
,,	24	,, ,,	...	11

These results showed that a marked decrease in the number of infections occurred where the plants were sprayed with the fluid containing salicylanilide. Further work on the value of salicylanilide for protecting tomatoes from attack will be undertaken.

Fumigation with sulphur dioxide

Where tomato plants under glass have been attacked by *Didymella* it is necessary to destroy spores of the fungus which may be present on the superstructure. It is also necessary to ensure that the old plants are destroyed, whenever possible by burning, immediately they are removed from the houses since the fungus will continue to grow on heaps of old tomato haulm which thus form a dangerous source of infection for the following tomato crop.

It is of great advantage to dry the remains of the old plants within the houses so that they can be burnt easily. Burning sulphur in the glasshouses after severing the stems of the plants a few inches above the ground greatly hastens the drying of the old plants.

The effect on the fungus of fumigating by burning sulphur was therefore investigated under practical conditions in a small glasshouse. It was found that spores of *Didymella* which had emerged from the pycnidia were destroyed when sulphur was burnt at the rate of 1 lb. per 1,000 cubic feet of glasshouse capacity except those in positions where draughts through cracks, etc., prevented a sufficiently high concentration of sulphur dioxide.

Spores within pycnidia on the stems of diseased plants were not killed and consequently the one fumigation by burning sulphur to dry off the old plants cannot be regarded as an effective method of disinfecting the superstructure of the houses since viable spores will be liberated from the diseased stems when the old plants are taken out of the houses.

After removing the old plants the houses should be cleansed by thoroughly spraying down with a 1 in 50 solution of 40% formaldehyde or a tar acid sterilising fluid at the same strength. Where the houses are " tight " and free from cracks sulphur can again be burnt at the rate of 1 lb. per 1,000 cubic feet glasshouse capacity. The necessity of thoroughly washing down the wires after burning sulphur must not be forgotten.

5. Stem Rot of Tomato caused by *Phytophthora parasitica*

P. H. Williams and Enid Sheard

During 1943 a new type of Tomato Stem Rot was observed and shown to be caused by *Phytophthora parasitica*. The lesions were from one to four feet above soil level. They were elongated, up to one foot in length and the stem became girdled only at an advanced stage of the disease. The colour of the lesions was greyish green and the outside of the stem was thrown into longitudinal folds as a result of the destruction of the cortex and pith by the fungus. The tissues were dark brown in colour for a short distance above and below the lesion.

The disease may be distinguished from that caused by *Didymella lycopersici* by the folding of the tissues, by the fact that the epidermis remains firm and is not so easily scraped off and by the absence of pycnidia. Lesions caused by *Botrytis cinerea* are pale brown in colour and usually the characteristic grey mould is present.

The fungus was readily isolated from the diseased stems. The disease was reproduced by spraying the stems of healthy tomato plants with a suspension of zoospores and keeping the plants under moist conditions for 48 hours. Lesions appeared in 3 days and the fungus was reisolated from them. Infection took place most readily where leaves had been removed before inoculation but in the field cases have been observed where the fungus appeared to have penetrated healthy and undamaged areas of the stem.

Infection may come from the soil or from fruit suffering from Buck Eye Rot. In two of the three cases observed, this disease is known to have been present on the bottom trusses. In one case, mummified fruit were found on the bottom trusses which proved to be infected with *Phytophthora parasitica*. In some cases mycelium bearing sporangia was found at the calyx end of the fruit. It is possible that such sporangia may be splashed or carried by air currents up to the stems above. In both nurseries, shortage of labour had led to the plants not being trimmed as frequently as usual so that top growth was dense and would afford ideal conditions for the germination of the sporangia.

Control of this disease would appear to consist in trimming the plants and ventilating the houses so as to prevent moist stagnant air conditions and in removing all fruit suffering from Buck Eye Rot. Mulching the ground with straw to prevent splashing from the soil may also be recommended where the ordinary Foot Rot due to *P. parasitica* has been prevalent.

A short illustrated account of this disease was published in the Gardeners Chronicle, Vo. CXIV, No. 2959, p. 96, 1943.

6. The Development of Tomato Plants infected with Spotted Wilt

I. W. Selman

It has been shown (J. Pom. & Hort. Sci. XX 1943) that crop plants infected with tomato mosaic virus at an early stage may still yield a heavy crop of fruit, if the environment is favourable. Infection with the Spotted Wilt virus, however, has usually entailed rogueing and destroying all infected plants. Some preliminary experiments have been made with the object of seeking some cultural treatment, which might make the " growing on " of infected plants a commercial proposition. Results to date have not been completely satisfactory, but there are indications that further research may make this possible, providing the insect thrips is controlled.

Tomato plants variety " Potentate " at the 8 to 9 leaf stage were planted in ten inch pots on 29th March, 1943. Fifteen plants were grown in a mixture of strawy stable-manure 2 parts, compost 2 parts and maiden loam 1 part, and the same number in a mixture of peat 2 parts and loam 3 parts. All pots received the same base fertiliser consisting of superphosphate, hoof meal, bone meal and dried blood. The soils were all carefully mixed, nevertheless no two plants reacted to Spotted Wilt with identical symptoms in either treatment.

There was little indication of any marked difference in the growth of plants grown in the two soil mixtures, although in the later stages the peat-grown plants appeared to be slightly more vigorous. Tests were made on several occasions of the virus content of the plants and contamination with tomato mosaic virus was found to occur in old plants.

Two developmental symptom pictures are presented below for plants receiving apparently identical soil treatments. No explanation of the different reactions of these two plants can be given. At present such differences must be presumed to be due to small differences in the vigour of individual plants. Factors affecting individual vigour, which is of such importance in virus-tolerance studies, await further research.

Plant No. 20

March 29th—Plant at 8-9 leaf stage in 10 inch pot containing peat-soil mixture.

March 30th—All leaves inoculated with Spotted Wilt Virus.

April 10th—Plant hardening slightly. Leaves showing yellow blotches.

April 12th—Chlorotic spots beginning to appear on leaves.

April 14th—Spots beginning to dry out and turn brown.

April 16th—Brown necrotic spots on the leaves.

Plant tested. Typical spotted wilt present only.

April 27th—Top growing but showing severe purpling of veins and margins of leaves. Mid-leaves showing slight yellow necrosis.

May 8th—Top very vigorous and green—apparently healthy.

May 20th—Plant tested. Typical spotted wilt present only.

June 2nd—Secondary brown spots appearing on young leaves—slight leaf distortion evident.

June 12th—Tops distorted. Young leaves mottled.

July 7th—Top bunchy, leaves mottled.

Centre leaves showing white, yellow and brown patches.

Four trusses present bearing a total of 22 fruits.

June 20th—Plant tested. Leaves—spotted wilt and tomato mosaic present.

Fruit—Tomato mosaic only present.

In this plant contamination with tomato mosaic virus evidently occurred about the end of May. It is clear that if a method can be found to bring, and keep, all plants in the condition in which this was on May 8th, some control may be practicable. Of the 30 plants studied, 8 showed green, vigorous tops on May 8th.

Some plants however developed in a relatively unsatisfactory manner. One such example is detailed below.

Plant No. 25

March 29th—Plant at 8-9 leaf stage in 10 inch pot containing peatsoil mixture.

March 30th—All leaves inoculated with Spotted Wilt Virus.

April 10th—No symptoms of disease.

April 12th—Slight hardening of whole plant.

April 14th—Slight browning of the young leaves. Leaves reflexing.

April 16th—Brown areas drying out. Plants tested. Typical spotted wilt only present.

April 27th—Top growing slightly. Young leaves yellowy green. Mid-leaves showing yellowy-brown necrosis.

May 8th—Tops showing yellowing. Growth poor. Severe brown stem streaks present.

May 20th—Plants tested. Typical spotted wilt only present

June 2nd—Tops green and apparently healthy but middle leaves showing secondary brown spotting.

June 12th—Tops distorted and mottled.

July 7th—Tops bunchy, mottled and distorted. Centre leaves showing white yellow and brown patches. One truss only with a single fruit present.

July 20th—Plants tested. Leaves—Spotted wilt and tomato mosaic present. Fruits—Spotted wilt and tomato mosaic present.

The above results may also serve to remind growers that spotted wilt and tomato mosaic viruses can, and frequently do occur in the same plant. In such cases the symptoms exhibited by the plant are commonly most like those of the mosaic disease viz. leaf distortion, mottling, etc., and in the fruit, ripening appears to lead to the inactivation of the spotted wilt virus. Fruits taken from nine plants from which spotted wilt had previously been isolated were tested for virus content on July 20th and the results are shown below. Contamination with tomato mosaic virus is evident but it is clear that the spotted wilt virus tends to disappear in the fruit. It may be recalled that the spotted wilt virus is not transmitted through the seed.

Virus content	No. of plants	
	Green fruit	Ripe fruit
Spotted wilt present with Tomato mosaic	3	2
Tomato mosaic only present	4	6
No reaction on test plants *i.e.* viruses in very low concentration, if present ...	2	1

7. The interrelation between mosaic infection, soil conditions and blotchy ripening

I. W. Selman

It has long been recognised by growers that the tilth and texture of the soil are factors of importance in determining the quality of tomato fruits. Since blotchy ripening also appears consistently in association with mosaic infection, an experiment was carried out to discover to what extent soil conditions would modify the incidence of blotchy ripening in association with mosaic infection.

Plants of the variety " Potentate " were grown in ten-inch pots in a cucumber house to the five truss stage. Details of experimentation were similar to those already described (J. Pom. & Hort. Sci. XX. 49-58 ; 89-106). Nine soil treatments were given as follows:

U.	Unsterilised soil of the house.
PU.	75% unsterilised soil of the house, plus 25% peat.
PUM.	75% unsterilised soil of the house, plus 25% peat, plus minor elements.
S.	Soil of the house steam-sterilised.
SP.	75% soil of the house steam-sterilised plus 25% peat.
UM.	Unsterilised soil plus minor elements.
D.	75% unsterilised soil plus 25% stable manure.
Cp.	75% unsterilised soil plus 25% composted tomato haulms.
CD.	62% composted tomato haulms plus 38% stable manure (No soil).

The amounts of added fertilisers were the same in all treatments each pot received the following base :

Hoof and horn	...	½ ounce.
Superphosphate	...	½ ,,
Bonemeal ...	...	½ ,,
Dried blood ...	...	½ ,,
Sulphate of potash		⅛ ,,

Top dressings of blood, super and sulphate of potash were applied at regular intervals. The total quantity of sulphate of potash applied, including base, was ⅞ ounce per pot.

One-half of the plants were inoculated with tomato mosaic virus when the first truss was in bud, the remainder being uninoculated controls.

The total yield of fruit from five trusses is shown diagrammatically in fig. 1, in which the proportion of unblemished to blotchy fruit is also indicated. It is of interest to note that the yield of unblemished fruit from both mosaic-infected and control plants was highest for plants grown in the mixture of soil and stable manure. Higher total fruit yields were obtained from other treatments but the proportion of blotchy fruit was considerably increased in such cases. For practical purposes it is clear that of the treatments studied the mixture of soil and stable manure is best suited for commercial needs *i.e.* the treatment producing a reasonably heavy yield together with good quality fruit and this result is applicable to both mosaic-infected and uninoculated control plants.

Effect of peat

The addition of peat to the soil led to an increase in the percentage of fruit showing blotchy ripening but the increase was greater and highly significant in the case of mosaic-infected plants as against the controls (see Table 1).

Table 1.
Fruit showing blotchy ripening.

Treatment	Controls	Mosaic-infested	
Soil only (U, UM & S)	18.4%	25.4%	Significant difference = 9.2
Soil plus peat (PU, PUM & SP)	25.1%	37.4%	

In fig. 2 is shown the percentage of blotchy fruit for each of five trusses for mosaic-infected and control plants grown in soil only and in soil plus peat. It will be seen that the difference in reaction of mosaic-infected plants in the two soil treatments was greatest in the third and fourth trusses. It has sometimes been noted that the greater the total weight of fruit produced the greater is the proportion of blotchy fruit. Comparison of the total fruit yields of trusses 3 and 4 of the mosaic-infected plants (Fig. 3) shows that the yield of fruit on truss 3 was significantly greater in plants grown in soil alone, although the percentage of blotchy fruit was significantly *less* than that of plants grown in soil plus peat. In truss 4 there was no difference in fruit yield of the infected plants although again the percentage of blotchy fruit was greater in soil and peat than in soil alone.

It is evident that under the conditions of this experiment mosaic-infected plants grown in a soil-peat mixture reacted in a manner distinct from that of the uninoculated controls with respect to the production of blotchy fruit. Where mosaic infection is likely to be widespread, the incorporation of large quantities of peat into the soil may prove very detrimental to fruit quality.

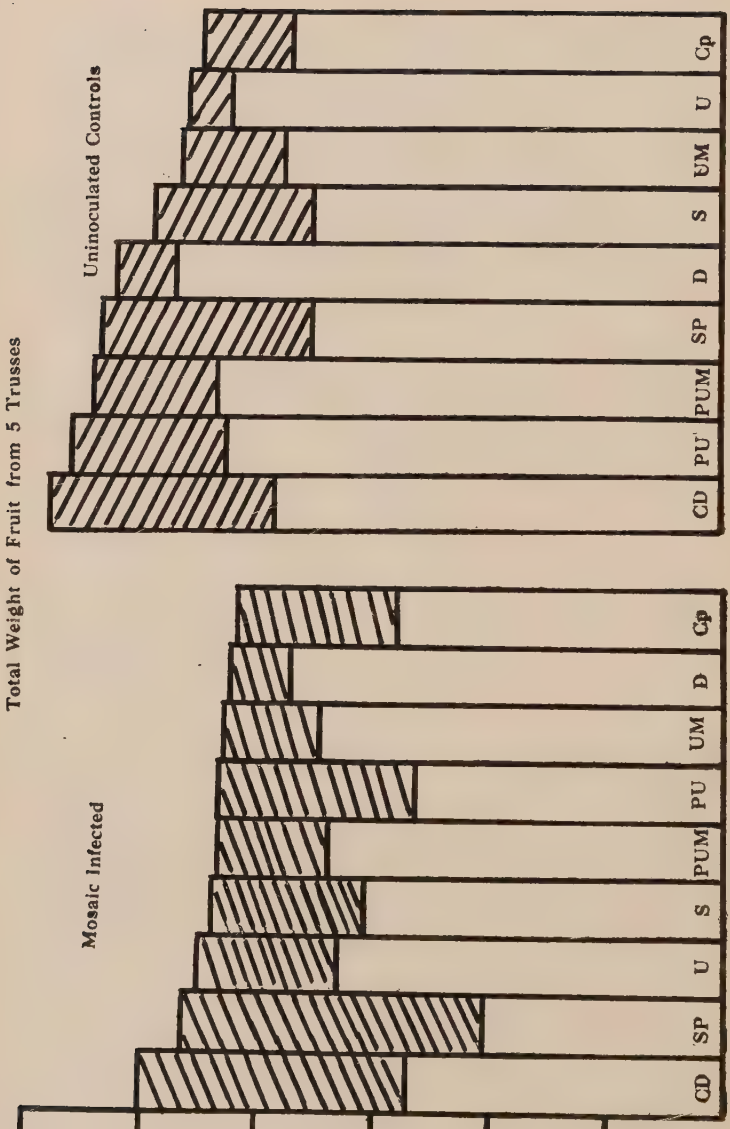


Fig. 1
Total Weight of Fruit from 5 Trusses

For Key see text.

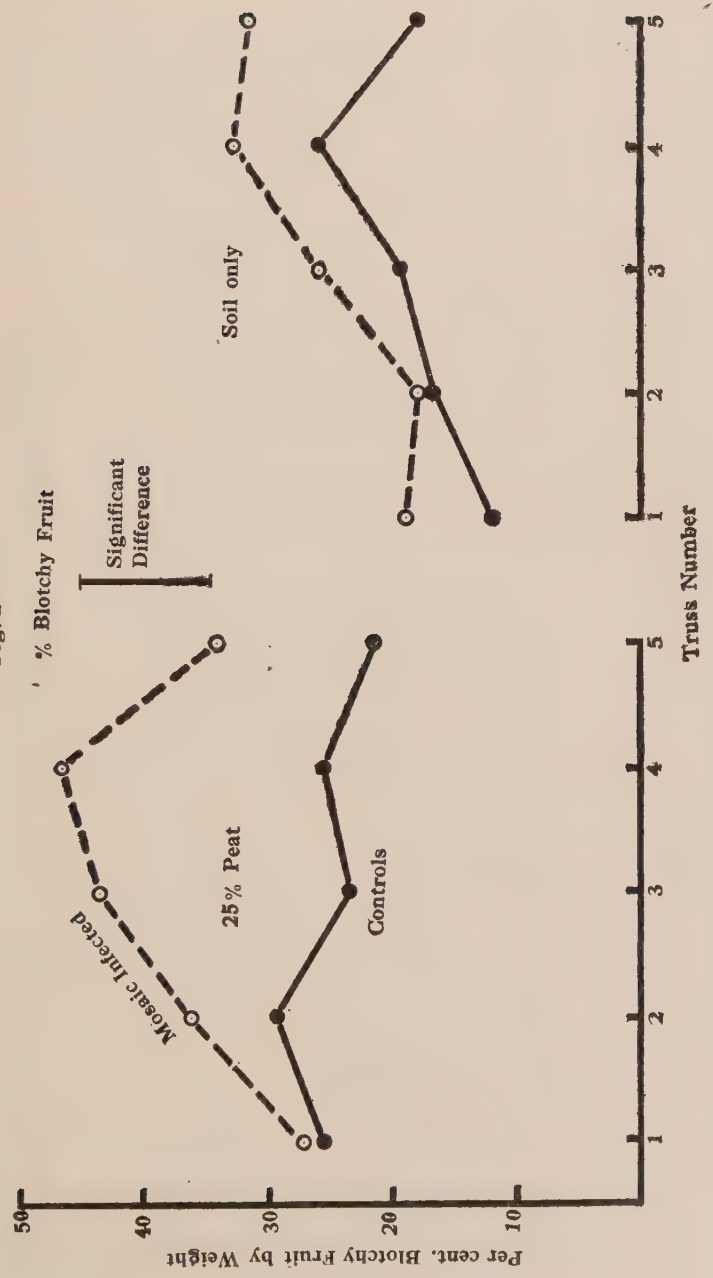
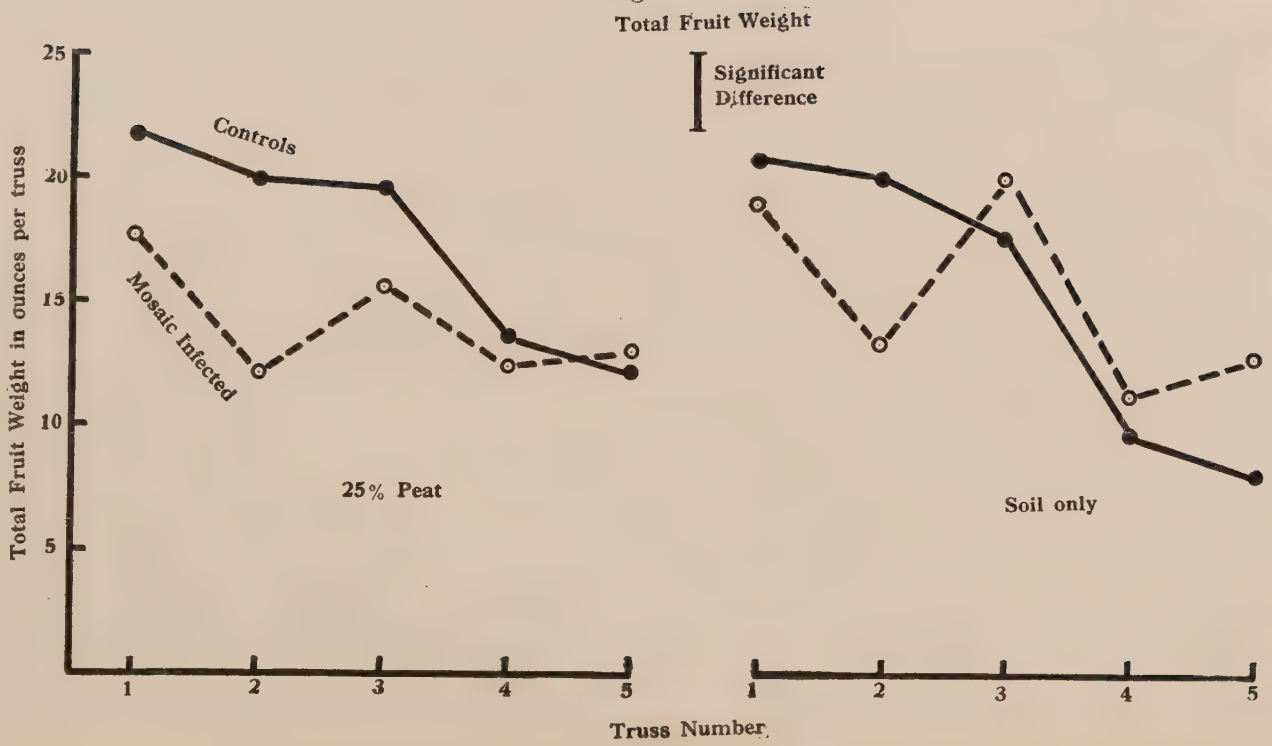


Fig. 2
% Blotchy Fruit
Significant Difference
Soil only
25% Peat
Controls
Mosaic Infected
Per cent. Blotchy Fruit by Weight
50
40
30
20
10
1
2
3
4
5
Truss Number

Fig. 3


Total Fruit Weight
Significant Difference
Controls
Mosaic Infected
25% Peat
Soil only
Total Fruit Weight in ounces per truss
25
20
15
10
5
1
2
3
4
5
Truss Number

Effect of Steaming

Pathogenic organisms were not present in the soil so that effects on the plant of steaming the soil may be attributed primarily to physical and chemical changes. In Table 2 is shown the percentage of blotchy fruit produced by plants grown with steamed and unsteamed soil together with the total fruit yields.

Table 2.

Treatment	% Blotchy fruit		Total fruit yield (oz. per plant)	
	Control	Infected	Control	Infected
Unsterilized U & PU ...	15.9	33.1	81.3	70.4
Steamed S & SP ...	29.9	41.8	81.4	71.8
Significant difference ...	11.3		11.4	

Steamed soil thus tended to increase the proportion of blotchy fruit in both control and mosaic-infected plants, but to a lesser extent in the latter.

Effect of compost plus stable manure (without soil)

It is of interest to note that this mixture, which is unlikely to be used in practice, gave the heaviest fruit yields from both control and mosaic-infected plants (see fig. 1).

Aeration and drainage were exceptionally good in this mixture, indeed it proved very difficult to keep the pots moist in midsummer. A very high proportion of blotchy fruit resulted from this treatment.

Effect of Minor elements

A solution containing the elements B, Zn, Mn, Cu, Mg, Mo, Fe, and Cl was watered on to the soil in the series UM and PUM, on nine occasions at fortnightly intervals. No effect on total fruit yield was found by this treatment in either healthy or infected plants, but the amount of blotchy fruit was reduced in the mosaic-infected plants (see Table 3).

Table 3.

Treatment	% Blotchy fruit	
	Control	Mosaic-infested
UM ...	18.3	19.3
U ...	8.6	26.8
PUM ...	20.3	22.0
PU ...	23.9	39.0

The plants grown without additional minor elements were apparently normal and did not differ in colour or size from plants receiving these elements. It seems reasonable to suppose, therefore, that the effect of minor elements on blotchy ripening in the mosaic-infected plants may have been indirect *e.g.* some small effect on the hardness of the plant.

Conclusion

From the above results it has been concluded that one factor influencing blotchy ripening is the type of growth associated with the water-retaining properties of a particular soil mixture. This factor appears to be most favourable for quality fruit production with a soil-stable manure mixture for pot work. Steaming and addition of peat, without appropriate manurial adjustments, may lead to a watery or " soft " type of growth which is associated with blotchy ripening. A compost-stable manure mixture, without soil, led to extreme fluctuations in the water content of the soil, a condition which also was associated with blotchy ripening.

3. Animal Pests.

1. Red Spider-mite (*Tetranychus telarius* L.)

E. R. Speyer

(a) Cultural Experiments with Tomato plants

To determinine if attacks by the mite could be dimished in intensity by inducing a rapid but well-balanced plant growth early in the season, six plots each 4 ft. x 3 ft. were marked off in a small glasshouse. Prior to winter flooding, a dressing of 8 ozs. lime per square yard was applied, and later each plot received a base treatment of 10 lbs. horse manure, 6 ozs. hoof and horn, 4 ozs. sulphate of potash and 2½ ozs. bone meal per square yard (previous analysis of the soil having shown a high phosphate content). The plots were planted with variety E.S.1. on April 30th. Four plots received top-dressings at intervals of ten days throughout the growing season, starting on May 7th, at the following rates per square yard :—

Plots A. and A¹.—3 ozs. dried blood and superphosphate mixed in equal parts.

Plots B. and B¹.—3 ozs. proprietary fertilizer, containing sulphate of ammonia, dried blood and superphosphate.

Of the two remaining areas,

Plot C. received 2 ozs. per square yard proprietary fertilizer (as in B) applied at 14 day intervals starting seven weeks after planting out.

Plot D. received no top-dressing, except for small amounts unavoidably washed over from adjoining plots.

During the first six weeks just enough water was given to wash in the fertilizers : the first main watering was given on June 10th, when the fruit on the first and second trusses was swelling.

On May 27th tomato leaves heavily infested by mites were placed in contact with the centre plant of each row throughout the plots. By the first week in July, all the plants, irrespective of treatment received, had become severely infested.

In all plots the plants grew vigorously, in spite of continued increase of the mite until the end of August, when the infestation was brought under control by spraying with paraffin emulsion. The weight of fruit in lbs. per plant obtained from each plot was, A 7.44; A¹ 8.12; B 7.6; B¹ 8.3; C 6.81; D 8.37.

It is concluded that the application of top-dressings, even at an earlier date than is practised commercially, does not tend to check an infestation by the mite, but that a liberal base treatment with horse manure and fertilizer induces a subsequent vigour of

growth which enables the plants to withstand severe infestation without loss of crop until a time at which oil-emulsion sprays may be applied without risk of inducing oedema.

(b) Experiments in spraying with Petroleum Emulsions

It has long been suspected that a higher proportion of the eggs than of the resting and active stages of the mite are killed when oil-emulsions are applied to foliage, but confirmatory evidence of this appeared to be desirable.

Infested Tomato plants of variety E.S.1. grown in 32 size pots and 18 to 24 inches in height were sprayed by means of a syringe with six different proprietary brands of these emulsions, each at the concentration recommended by the manufacturer. Twenty-four hours after application, leaflets were cut from the plants and kept under observation in glass-top boxes for a further period of nine days. Counts then taken gave the percentage mortality obtained respectively for eggs, resting stages, and active stages of the mite.

Table 1.

Emulsion No.	% Mortality		
	Active stages	Resting stages	Eggs
1.	57.	88.	100.
2.	65.	96.	100.
3.	41.	78.	100.
4.	81.	95.	97.5
5.	70.	100.	100.
6.	45.	97.	100.
Control (water)	10.	0.	2.5

In the case of Emulsion No. 1 severe oedema developed upon the plants 7 days, and in that of Emulsion No. 5 slight oedema 16 days after application : no oedema followed application of the other brands.

Additional counts were made upon leaflets taken from plants 8 days after application, and in these the proportion of active mites and resting stages killed was somewhat higher.

It appeared possible that absorption of oil by the leaf-surface might be the cause of survival of a comparatively large number of active mites after spraying.

As a corrective addition of an hygroscopic salt to the spraying water suggested itself, and for this purpose calcium chloride was chosen.

It was necessary first to determine at what concentration a solution of calcium chloride could be applied without risk of injury to the foliage of tomato plants. Plants of variety Carrick in 32 size pots were sprayed with solutions ranging from 0.1% to 1.0% in

water. Up to a concentration of 0.25% the foliage was uninjured, and a small but possibly significant mortality of mites was obtained, *viz.* active mites 21%, resting stages 22%, and eggs 5%.

Employing the same series of oil emulsions under the same conditions as before, but with 0.25% calcium chloride solution, the following percentage mortalities were obtained.

Table 2.

Emulsion No.	% Mortality		
	Active mites	Resting stages	Eggs
1.	82.	91.	100.
2.	96.	100.	100.
3.	93.	92.	100.
4.	88.	100.	100.
5.	90.	94.	100.
6.	84.	100.	100.
Control (0.25% Calcium chloride)	29.	33.	12.5

In the case of Emulsion No. 1 slight oedema developed upon the plants 12 days after application : no oedema occurred amongst the plants sprayed with the remaining five brands.

It will be noted by reference to Table 1 that in every case the proportion of active mites killed was very considerably higher when calcium chloride was dissolved in the spraying water, and that this applied to a great extent also in the case of the resting stages, except in that of Emulsion No. 5. In experiments of this nature, latitude must be given for experimental error.

At the end of August, the severely infested tomato plants previously employed for cultural experiments were sprayed with a power machine. Emulsion No. 1 was applied to the plants on one side of the glasshouse, and the same emulsion with a 0.25% solution of calcium chloride to those upon the other.

Upon leaflets taken at random throughout the house 24 hours after application and kept under observation, the following percentage mortalities were recorded :—

Table 3.

Emulsion	% Mortality		
	Active mites	Resting stages	Eggs
Without calcium chloride	47.	100.	100.
With calcium chloride	72.	87.	100.

It was thought possible that a similar effect might be obtained by giving a second application of an oil emulsion shortly after the first. To plants of variety E.S.1. grown in 9 inch pots and averaging 8 feet in height, Emulsion No. 1 was applied from a power sprayer, and a second application was given 5 days after the first. Upon a large number of leaves examined subsequently, no living active mites or resting stages could be found, and very few of the many eggs present were viable.

The experiments were carried out almost entirely by Mr. Parr, and represent an important step forward in the control of this persistent pest.

(c) Distribution of infested plants in Tomato houses

In mid-June it was noticed that while many plants growing in the Experimental Station houses were severely infested with the mite, upon others the infestation had developed only to a slight degree or not at all.

An attempt, based upon visual estimation of the extent and severity of markings made by the mites upon the foliage, was made in order to ascertain however, roughly, the distribution of the more severely infested plants in some of the houses or in portions of them.

Essential particulars relating to these houses and the number of plants examined were as follows :—

House No. 4—100 ft. x 27 ft. : plants in rows of 10 on each side of the path. 200 plants at southern end : on east side 25%, on west side 69% severely infested.

House No. 5—100 ft. x 27 ft. plants in rows of 10 on each side of the path. 992 plants : on east side 56%, on west side 55% severely infested.

House No. 7—100 ft. x 15 ft. plants in rows of 5 on each side of the path. 462 plants : on east side 61%, on west side 75% severely infested.

House No. 8—As No. 7.
230 plants on east side : 64% severely infested.

Although severely infested plants occurred in the rows nearest to, and especially in those immediately adjacent to the gutters, by far the largest number were confined to the rows between the paths and purlin posts. For the sake of convenience, this is expressed below by giving the percentage of severely infested plants in selected numbers of rows more adjacent to the path on the one hand, and that in the remaining rows more adjacent to the gutters on the other :—

House No. 4—East side 2 rows nearest path 85% : 8 rows nearest gutter 10%.
West side 6 rows nearest path 97% : 4 rows nearest gutter 28%.

House No. 5—East side 5 rows nearest path 87% : 5 rows nearest gutter 25%.
West side 5 rows nearest path 90% : 5 rows nearest gutter 20%.

House No. 7—East side 3 rows nearest path 82% : 2 rows nearest gutter 30%.
West side 3 rows nearest path 82% : 2 rows nearest gutter 64%.

House No. 8—East side 3 rows nearest path 79% : 2 rows nearest gutter 42%.

This indicates either that the infestation had started originally upon plants growing nearest to the paths and had spread towards the gutters, or that plants growing between the purlins and the gutters were more resistant to attack by the mite. Observations made subsequently show the former to be the case and that when a high percentage of severely infested plants occurs amongst those growing between the purlins and the gutters, the infestation, at least in some cases, originates upon plants which have become infested in the propagating house and which are therefore placed haphazard in the houses.

It is probable that the female mites, when going into hibernation toward the end of the previous growing season, tend to move upwards upon the glasshouse structure and prefer to pass the winter outside under the ridge-capping and ventilator fittings. When spring approaches and the ventilators are opened for longer or shorter periods, the mites may drop from them and come into contact with plants growing in the rows nearest to the central path. If this should be the case, support, is given to the contention by growers that the mite enters the houses from outside soon after air is put on, though the origin of infestation is not from weeds and other vegetation growing in the vicinity of the houses, but from crevices in the region of the ridge in which the mites have passed the winter.

Provided that the plants in the propagating house are free of the mite, the results of these observations, which are certainly paralleled in houses which have been examined upon some commercial nurseries, are likely to modify considerably the amount of spraying necessary to keep the pest in check : early in the season it may suffice only to spray the plants which are grown between the paths and the purlin posts.

2. Wireworm (*Agriotes obscurus*, L.)

In continuation of observations made in 1942 (Ann. Rep. pp. 56-59) upon the effects of a high wireworm population upon lettuce plants within a confined area, the small glasshouse used previously was planted with Cheshunt Early Giant in January, but two areas

one in the north-eastern and the other in the south-western portion were left unplanted. In each of these a deep concrete tank was constructed with the top flush with the surrounding soil surface. The tanks were filled to within six inches of the top with soil, 205 wireworms (representing a population of $\frac{3}{4}$ million per acre of surface) were introduced into each, and soil added so that the wireworms could escape, if they were so inclined, into the surrounding planted areas.

On February 20th, 16 young lettuce plants (in four rows of four) were planted in the soil of each tank : four days later wheat was sown in a drill 3 inches wide and 2 inches deep running down the centre of the tank on the west side, while that on the east side was kept as a control. Two days later the wireworm population was raised to the equivalent of $1\frac{1}{2}$ millions per acre, by the addition of 200 wireworms to the soil in each tank.

The wheat-row showed above ground 9 days after sowing and 2 weeks later had attained a height of 8 to 9 inches ; it was lifted with 3 inches of soil beneath it on March 18th and 65 wireworms were recovered from the roots.

Mean temperatures recorded from February 20th to March 19th were as follows :—

Atmosphere Max. 80.4°F., Min. 50.0°F. Soil at a depth of 4 inches, in tank with wheat-row 53.3°F. in control tank 54.7°F.

Plants destroyed by wireworms were replaced, and in the following table the numbers attacked during each period marked by the growth of the wheat are given :—

Period in Wheat growth	Days	Lettuce plants destroyed	
		Tank with wheat	Control
Before sowing	3	6	3
Sowing to germination	9	17	12
After germination	14	11	19
After removal	14	4	5
Total	40	38	39

Thus there was a considerable fall in the number of plants destroyed in the tank containing the wheat-row during a period of 14 days after the wheat had germinated. After March 31st, the wireworms ceased to attack the plants altogether, and in the areas surrounding the tanks only 7 out of 152 plants were destroyed during the whole period, six of which were situated upon the eastern and warmer side of the house.

3. Root-knot Eelworm (*Heterodera marioni*, Cornu.)

Soil infested with Root-knot Eelworm has been treated with thymol, either in the form of a 40% emulsion or of sodium thymolate containing 20% thymol. The concentration of thymol was in all applications equivalent to about 1 part in 1,115 parts water, this representing, as nearly as convenient, a saturated solution in water.

At the end of March the soil mixed with suitable compost in 9 inch pots was watered with 780 cc. of solution, shortly before plants of the variety Potentate with the ball of soil round the roots intact, were planted in them. The numbers of further applications, always with the same quantity of solution, was varied from none to three, the latter over periods of one to two months. Plants similarly grown in the same soil without treatment were kept as controls.

The growth and yield of fruit did not appear to be affected by the treatments.

The roots were examined in October, and those of all the plants showed at least some eelworm infection.

There was, however, such variation in the extent of infestation, as judged from the number of galls present amongst the untreated controls, that no conclusions could be drawn from the experiments.

The same inconsistency was experienced in experiments with plants of variety E.S.1. grown in infested ground, and it may be of interest to note that upon the roots of lettuce grown subsequently upon the same areas, nodules made their appearance upon the roots of plants in the plot which had previously been treated with sodium thymolate solution, but none occurred upon those in an untreated plot. Until some satisfactory method of setting up reliable controls can be devised, no results of any value can be expected, unless, perhaps, more concentrated solutions of sodium thymolate are employed.

4. Chemical Problems

O. Owen

(a) General

The increase in the number of soils, fertilisers, etc., submitted for examination reported in recent years has been maintained. There is also a pronounced increase in queries which often require more than the routine examination associated with general advisory work.

From the commercial grower's point of view two experiences have been sufficiently general to merit attention. The first concerns the comparative failure of patches of winter lettuce grown under glass in soil which apparently yields uniform and satisfactory crops of tomatoes. The second concerns the failure of batches of tomato seedlings.

In several cases of irregular growth in lettuce which have been investigated the trouble has been traced to slightly acid conditions in the soil. Experiments in sand have shown that the optimum reaction for lettuce growth is about pH 6.5-7. Above this range lettuce do not appear to be unduly affected. Below pH 6.0, however, some varieties of lettuce do not grow satisfactorily and even at pH 5.5 there is a definite depressing effect. Tomatoes, on the other hand, thrive over a pH range of 5.5 to 8.0. This explains the apparent anomaly of satisfactory tomato growth under conditions unsuitable to lettuce. Despite the fact that liming and manurial treatment generally may appear to be uniform over a house or a block of houses it often happens that there are variations from place to place, particularly in the lime content. In some cases it has been found that the pH values vary between 5.4 and 6.7 in the same house. Over this range tomatoes will usually grow normally, but at the lower value lettuce will probably grow indifferently.

Obviously the condition can be corrected by the application of lime. It is clear that, to give the maximum effect, three conditions must be observed. Firstly the lime should be in a fairly fine state of division ; secondly it should be spread as uniformly as possible ; thirdly it should be mixed thoroughly with the soil. In all the soils with which we have dealt application of lime in this way has effected an improvement in the lettuce.

Failure of batches of tomato seedlings can be attributed to a variety of causes, but in some instances it has been traced to a lack of available phosphate in the compost used for sowing or for potting. Formerly it was a common practice to use old cucumber beds for this purpose and it would appear that chemically and physically this material was, after sterilising, eminently suitable for the purpose. For several reasons, one of which is the lack of old cucumber

beds, other mixtures have come into use in recent years. Many of these mixtures use turf or similar maiden material which after suitable treatment yield satisfactory results. Our experience is, however, that the amount of superphosphate used is often perilously near the borderline of deficiency. It must be remembered that rarely is a heap of stacked turf uniform in composition. Consequently a flat uniform addition of superphosphate may supply adequate available phosphate for part of the stack but still prove inadequate for another part. Hence the lack of uniformity in seedlings and young plants. To overcome this possibility it is recommended that to a hundredweight of compost 12-16 ozs. of 16 per cent. superphosphate be added and mixed intimately. Where the triple superphosphate is used the quantity is, of course, reduced to one-third of this amount. The addition of this quantity of phosphate eliminates the possibility of phosphate deficiency. At the same time, if the compost is naturally fairly rich in phosphate the amount recommended is not excessive and there is no evidence that it is harmful in any way. It should be added that this superphosphate should be used in addition to the other ingredients which are normally incorporated in the compost, and that an adequate level of nutrients in no way affects the need for sterilisation and hygienic practices generally.

Samples of widely differing materials which may have value as fertilisers have been examined. It is again necessary to emphasise the need for care and discrimination in buying untried materials for use on plants. The fact that a substance has a manurial value based on a chemical analysis is no guarantee that it can be used on plants and it is essential that any new material should be tried on a small scale before any general use is made of it. At the Experimental Station all such substances are treated in this way. In addition to chemical analysis trials are made on pot plants. When there is any urgency growers are advised to carry out small trials under their own conditions. Usually, if the material has an effect, either good or bad, this can be seen in 10-14 days after application. In some cases, however, we have found that an effect has not been apparent for five weeks after treatment. Sometimes the material has such a low value that it is hardly worth using under glass. For instance, a flue dust offered as a source of potash contained only 0.17 per cent. potash (K_2O). Other materials were rejected because of their unfavourable effect on plants when used in amounts considered to be reasonable.

Several samples of superphosphate suspected of causing damage have been examined but in no case was damage traced to this cause when used in reasonable amounts.

As usual a fair number of samples of wood and plant ashes have been received. The potash contents have ranged from 1.3 per cent. to 8.6 per cent. K_2O. All were tested on plants in pots by an application corresponding to 2 tons per acre with little, if

any, deleterious effect. In this connection it must be reported that in several instances ash dressings considerably in excess of that now mentioned have been used in borders during the winter and growth has been satisfactory. At the same time careful records on one commercial nursery show that excellent crops of good quality fruit have been produced with dressings varying from $\frac{3}{4}$ to $1\frac{1}{2}$ tons per acre.

Five cases of suspected chlorate injury have been dealt with. Only in two of these were the tests positive and the injury was so mild as to be of little importance.

Since the use of muriate of potash has been made necessary by the prevailing conditions we have included in our standard soil analysis a determination of the total chlorides in soil to ensure that the chloride concentration does not become excessive. The concentration of chloride varies widely and as will be shown later in this report tomato plants can tolerate surprisingly high concentrations provided such concentrations are not maintained for any length of time. In this connection we continue to find appreciable amounts of chloride in water supplies which have been considered relatively free from chloride. For instance, a nursery bore in West Sussex gives water containing 91 parts sodium chloride per 100,000.

(b) The use of Muriate in place of Sulphate of Potash

Houses 7, 8 and 9 have now been used for four consecutive years in this experiment and the effects on crop production are dealt with elsewhere in this report. During the year samples of soil from each of the four plots in each house have been analysed for chlorides. Results for the year at approximately monthly intervals are shown in table 1.

As will be seen from the table the values show wide fluctuations. Base fertilisers had been added to the soil before this series of determinations began. Watering prior to January 7th no doubt depressed the chloride values and made them lower than they would have been otherwise. On April 15th all the plots were dressed with 2 ounces per square yard of muriate or sulphate and half this amount was applied again with an equal amount of dried blood on April 24th. These dressings of 3 ounces were reflected in the chloride values shown under May 1st when maximum values were recorded for most of the plots. The highest value found during the whole year, 0.23, was on this date in the muriate plot 4 in house 7. Within the month, however, this had fallen to about one-third the maximum and this no doubt is due to the fact that during this period fairly heavy watering was taking place regularly. After April none of the plots were treated with muriate or sulphate and this is reflected in the

Table1. Showing Total Chlorides as Sodium Chloride (%) for Soil dried at 100° C.

House	*Plot*	*Jan. 7th*	*Feb. 8th*	*Mar. 23rd*	*Apr. 1st*	*May 1st*	*June 2nd*	*June 29th*	*Aug. 3rd*	*Sept. 8th*	*Sept. 26th*	*Nov. 10th*	*Dec. 6th*
7	1s	.03755	.02953	.02050	.02050	.04281	.04496	.02648	.02348	.01481	.008806	.008439	.007591
	2m	.09303	.08720	.06956	.07171	.1148	.06291	.07771	.03827	.03043	.03704	.01024	.005948
	3s	.01453	.01455	.01600	.01187	.02894	.02157	.02833	.02280	.01132	.01428	.009598	.009373
	4m	.08110	.08582	.06200	.05319	.2309	.08017	.05383	.03448	.05639	.03260	.01184	.005924
8	1m	.09486	.1108	.05023	.1070	.03185	.04741	.1084	.09389	.04553	.03573	.02077	.008210
	2s	.03283	.01293	.01846	.02067	.02271	.02600	.0409	.02569	.01406	.008333	.008636	.007180
	3m	.08387	.08816	.07832	.07141	.1409	.02177	.08390	.04732	.03495	.03583	.02356	.008174
	4s	.02126	.01887		.01574	.04024	.02431	.02667	.01628	.009044	.01369	.007364	.009788
9	1m	.1352	.1413	.06193	.06939	.1801	.08760	.06645	.03580	.04270	.04509	.006966	.007964
	2m	.1466	1447	.1279	.1317	.1309	.05830	.03350	.02790	.03933	.02812	.02711	.01047
	3s	.01801	.01953	.02153	.02133	.005244	.01600	.01698	.01816	.01578	.007649	.01348	.007161
	4s	.01687	.01190	.01804	.01803	.03397	.01774	.01994	.01427	.01030	.01091	.01188	.01124

chloride values which with one exception showed a continuous reduction until September when the plants were taken out. In September all the houses were steamed and between September 8th and December 6th all were flooded very heavily. In the aggregate it was calculated that water was applied at the rate of 400,000 gallons per acre. The effect of this is seen in the low values recorded on December 6th. On this date the values for the sulphate plots varied from 0.0072 and 0.011, and for the muriate plots from 0.006 and 0.01. In other words, provided sufficient water is used and this is reasonably free from chlorides excess chlorides can be removed from the soil.

It was reported in 1942 that for a short time during June plants growing in soil treated with muriate were paler in colour than those growing in soil receiving potash as sulphate. The effect soon passed off.

In 1943 an attempt was made to make some measurement of this effect.

During the first week in May it was noticed that some of the plants appeared to be paler in colour on the muriate plots, and the effect was more pronounced on Potentate than on E.S.1. On May 13th the effect was more definite and it was considered sufficiently so to assess the amount. This was done by examining each plant in every plot and classifying it as definitely pale (called yellow below) or definitely normal. This ruled out the doubtful ones and also those which might be suffering from any other disorders. This was repeated on subsequent dates with results as shown in Tables 2 and 3. The figures are grouped together to save space and in the case of Potentate refer to a total of 480 plants and in the case of E.S.1. to 240 plants:—

TABLE 2

Potentate

	May 13*th*	*May* 24*th*	*June* 2*nd*	*June* 16*th*	*July* 5*th*	*July* 19*th*	*Aug.* 17*th*
" Yellow " ...	37	60	60	50	27	33	0
" Normal " ...	353	193	198	270	394	417	

TABLE 3

E.S.1.

	May 13*th*	*May* 24*th*	*June* 2*nd*	*June* 16*th*	*July* 5*th*	*July* 19*th*	*Aug.* 17*th*
" Yellow " ...	10	20	18	12	9	8	0
" Normal " ...	187	106	102	100	148	196	

It would appear, therefore, that the peak effects occur somewhere between May 24th and June 2nd in both Potentate and E.S.1. and these effects can be associated with the high values for soil chlorides which persist in the soil until some time in May.

Another fact which emerges from these figures is that E.S.1. is not affected so acutely as is the variety Potentate. In the latter the maximum number of plants affected is 12½ per cent., while in the former it is only 8¼ per cent.

In both varieties the effects disappear as the season advances and the early chloride in the soil is washed out, so that by the middle of August in neither variety were there any apparent indications of harmful effects due to the chloride.

Samples of the foliage from some of the plants were taken in May, June and at the end of the season. Unfortunately the May samples became contaminated with chloride while drying and it is only possible to give data for June and September samples. These are in Table 4 :—

TABLE 4

			Chloride in dry matter of foliage (% Cl) h.c.	
Plot	*Treatment*	*Variety*	*June 21st*	*September 8th*
71	Sulphate	Potentate	2.130	1.591
72	Muriate	,,	5.252	3.035
73	Sulphate	,,	1.944	2.257
74	Muriate	,,	4.146	2.648
81	Muriate	,,	5.277	3.125
82	Sulphate	,,	2.044	2.264
83	Muriate	,,	5.144	3.403
84	Sulphate	,,	2.664	2.765
91	Muriate	E.S.1.	.975	3.354
92	Muriate	,,	5.272	3.614
93	Sulphate	,,	3.254	1.847
94	Sulphate	,,	2.529	3.164

In view of the fact that Potentate reacts more definitely to soil chloride than does E.S.1. it was expected that possibly its foliage would contain more chloride. These figures do not bear this out.

(c) Trace elements in Tomato Nutrition

The preliminary work described last year has been continued but time and pressure of other work have not permitted of as detailed work as one would have wished.

Boron

The results reported last year have been confirmed and it has to be recorded again that, despite the general depressing effect and the foliage symptoms after boron has been withheld the growing point of the plant appears to keep green and alive for some weeks after the rest of the plant is to all intents and purposes dead.

Iron

For some considerable time it was found impossible to produce any effect on young plants by omitting iron from the nutrient solution. As already reported reagent chemicals and distilled water were used throughout and reaction of the nutrient solution was maintained. It was thought that the sand at pH 6—6.5 used may have contained sufficient iron to meet the plant's requirements. This seemed unlikely in view of the high silica content but to eliminate this possibility one batch of sand was washed thoroughly with hot nitric and hydrochloric acids and finally washed repeatedly with distilled water. Even then no effects on the plant were observed until two trusses of fruit were swelling. At that stage a greyness manifested itself in the upper leaves but at no time was this very pronounced, and it never appeared to have a serious effect on the plant. This was repeated and the same results obtained.

Magnesium

Last year what appeared to be a characteristic leaflet tip burn was recorded where magnesium sulphate was omitted from the nutrient solution. This may have been due to three causes, namely, magnesium deficiency, sulphate deficiency, or, least likely, a deficiency of magnesium sulphate. It must be pointed out that at that time all the magnesium used was in the form of magnesium sulphate and this formed the greater part of the sulphate in the solution. This year the composition of the solution was altered so that although the ionic composition was altered but little, magnesium was used in the form of nitrate and potassium as sulphate instead of as nitrate. With this new mixture no leaflet tip burn was observed although the characteristic chlorosis associated with magnesium deficiency developed in the usual way. It would thus appear that the tip burn observed is to be associated with sulphur deficiency. It should be added that traces of sulphate were in fact included in this later nutrient in the form of other salts so that there was not an absolute absence of sulphate.

In another series of plants varying amounts of magnesium (as nitrate) were used in the nutrient solution. Under these conditions it was surprising how long the plants grew with as little as a quarter of what may be termed the "normal" amount of magnesium providing all the other nutrients are kept at adequate levels. It was not until fruit formation had set in that serious chlorosis

developed. This is in accordance with most commercial experience in which magnesium deficiency symptoms only develop when the plant is undergoing a serious strain.

Indications were obtained that a high level of nitrogen as ammonium nitrate in the nutrient will delay the appearance of or mask the symptoms usually associated with mild magnesium deficiency.

Manganese

The results already recorded were obtained again, and it was found in accordance with the experience of other workers that spraying a manganese deficient plant with dilute manganese sulphate solution was more effective than permanganate solution in equivalent strength in correcting the condition.

General

Although no quantitive observations have been possible there are definite indications that the severity and even the appearance of deficiency symptoms are due not only to the element which is deficient but also to the level of other elements in the nutrient solution. For instance, magnesium deficiency is related to nitrogen while iron and manganese are interrelated and possibly manganese and magnesium.

Secondly it is interesting to note that when plants are treated with a nutrient solution made up in ordinary tap water they always made rather better growth than those treated with the same nutrients dissolved in distilled water.

Thirdly despite the fact that plants were grown by the drip method and consequently were never short of water quite a number of the fruits showed blossom end rot.

(d) The effect of Sulphur and Sulphuric Acid on the reaction of a Tomato Soil

Experiments have been commenced in house 5 on the effect of a reduction in soil reaction on the tomato crop. Two plots were treated with 2 ounces and 4 ounces per square yard respectively of sulphur and a third plot treated with sulphuric acid equivalent to 2 ounces of sulphur per square yard. There has been a reduction in the reaction as shown below but this is still fairly high due, no doubt, to the fact that the soils all contained so much carbonate at the commencement of the experiment.

One interesting feature has been observed. After the addition of the sulphuric acid the pH fell from 8.62 to 6.39 in about a week but within a month it had risen again to 7.84. This suggests that lime moves upwards during the ordinary cultural operations although it must be mentioned that no digging took place at this time.

TABLE 5

Effect of Sulphur and Sulphuric Acid on Soil pH.

Treatment	pH before treatment	pH at end of season	Crop in tons per acre
2 ozs. sulphur per sq. yd.	8.91	7.74	56.40
4 ozs. sulphur per sq. yd.	8.79	7.45	58.28
Sulphuric acid	8.94	7.17	56.78
Control			56.24

The Determination of Available Potash and Phosphoric Acid in Tomato Soils

O. Owen and P. Rees

Since Dr. Bernard Dyer introduced 1 per cent. citric acid solution as a solvent for available potash and phosphoric acid in soils, other solutions have been suggested for this purpose and in some laboratories have superseded the older method.

Dr. Dyer's method has been used in these laboratories during many years in the analysis of soils for advisory purposes. For some time it has been felt that some of the more modern methods might be more economical and as a result investigations have been initiated during the year to examine this possibility. Insufficient data are available as yet to merit any conclusions but it would appear that for ease of working on our soils N/2 acetic acid is to be preferred to the other extractants so far examined.

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Manurial Treatment in Tomato Experiments.

(Except plots in Appendix C)

(1) Lime.

All houses with the exception of Plots 2, 5 and 6 in house 4 received ground caustic lime at the rate of 1 ton.

(2) Base Dressing.

Houses 1-5 and the Rose House were steamed and received sulphate of potash at the rate of half ton per acre only.

All the remaining houses received, hoof and horn, bone meal and sulphate of potash at the rate of half ton per acre.

(3) Top Dressings.

Sulphate of Potash—All houses received a first top dressing of sulphate of potash at the rate of 5 cwts. per acre excepting those receiving muriate of potash in Houses 7, 8 and 9.

Fertilisers Mixture—All houses except plots 1, 2, 5, 9 and 10 received 5 cwts. per acre of the following mixture every fourteen days at discretion :—

3 parts sulphate of ammonia.
2 parts dried blood.
7 parts 30% superphosphate.
5 parts pure dissolved bones.
½ part bone flour.
2½ parts sulphate of potash.

All houses received three top-dressings of the following mixture at the rate of 5 cwts. per acre :—

1 part sulphate of ammonia.
1 part nitrate of potash.
3 parts superphosphate.
5 parts dried blood.

except the nutriate of potash plots in houses 7, 8, and 9, where muriate of potash was given instead of sulphate of potash.

Appendix C.

Manures applied to Plots 1-3, and 10-12 in Tomato House 4.

Plot.	TITLE.	Base Manure in Lbs. per sq. yd.				* Top-dressing in Lbs. per sq. yd.			
		Lime.	Stable Manure.	Basic Slag.	Sulphate of Potash.	Super-phosphate.	Sulph. of Ammonia.	Nitrate of Soda.	Sulph. of Potash.
1	Complete Artificials (I.) without Nitrogen	1.0	—	0.4	0.1	0.5	—	—	0.2
2	Unmanured	1.0	—	—	—	—	—	—	—
3	Complete Artificials	1.0	—	0.4	0.1	0.5	0.2	0.2	0.2
10	Complete Artificials with Dung	1 0	7	0.4	0.1	0.5	0.2	0.2	0.2
11	Complete Artificials without Phosphates	1.0	—	—	0.1	—	0.2	0.2	0.2
12	Complete Artificials without Potash	1.0	—	0.4	—	0.5	0.2	0.2	—

* The Top-dressing was applied in eight equal instalments.

Appendix D.

Dates of Cultural Operations, 1942—1943.

Crop.	Sown.	Potted into 60's.	Planted out in borders.	First Top Dressing.	First Fruit Picked.	Last Fruit Picked.
Tomatoes ...	Dec. 21 1942	Jan. 25 1943	Mar. 9 1943	April 24 1943	May 21 1943	Oct. 22 1943

Month.	Air Temperatures						Grass Temp.			Rainfall				Mean Soil Temperatures		Hygrometer				Bright Sunshine		Barometer
	Mean		Absolute Max.		Absolute Min.		Av. Min.	Absolute Min.		Total Precipitation	No. of Days P'p'tn	Greatest Fall				Dry Bulb	Depres. of Wet Bulb	Relative Humidity %	Dew Point	Total No. of Hrs.	Daily Average.	
	Max.	Min.	Tem.	Date	Tem.	Date		Tem.	Date			Amt.	Date	1 ft.	2 ft.							
	°F.	°F.	°F.		°F.		°F.	°F.		Ins.		Ins.		°F.	°F.	°F.	°F		°F.			Ins.
January	45.7	35.0	55.0	29th	23.0	8th	31.9	20.0	3rd	4.94	21	0.64	31st	39.1	40.2	39.6	0.8	92.8	34.2	38.6	1.25	29.66
February	49.2	34 6	58 0	14th	23.0	7th	31.3	20.0	7th	1.20	9	0.44	1st	40.0	41.4	40.0	1.4	88.7	36.7	81.6	2.91	30.10
March	53.9	35.4	61.0	16th	26.0	7th	31.3	21.0	7th	0.39	6	0.26	24th	40.9	41.9	42 5	1.9	85.9	38.2	119.1	3.84	30.07
April	62.6	42.7	78.0	16th	31.0	19th	37.5	25.0	19th	1.01	12	0.28	23rd	52.4	49.4	54.8	4.4	73.5	46.2	147.0	4.90	30.08
May	66.8	46.5	85.0	14th	35.0	6th, 10th	43.0	30.0	6th	1.68	10	0.47	10th	58.2	55.2	59 0	5.4	70.4	48.9	255.6	8.25	30.02
June	69.9	50.2	81.0	11th	43.0	16th, 21st	46.7	38.0	3rd, 16th	1.36	9	0.47	7th	61.8	60.4	61.9	4.4	75.5	53.7	198.9	6.63	30.06
July	74.1	52.8	92.0	31st	45.0	8th, 23rd	49.8	41 0	7th, 8th	1.86	11	0.44	30th	63.1	62.1	64.4	5.0	73.5	55.4	200.2	6 46	29.97
August	73.6	52.8	83.0	18th, 20th, 21st	42.0	11th	49.2	38.0	11th	1.51	14	0.32	11th	63.3	62.6	65.1	3 3	81.5	59.0	185.0	5.97	29.80
September	66.6	47.1	74 0	12th	33.0	22nd	43.4	30.0	22nd	2.13	13	0.34	27th	57.2	58.1	58.8	3 5	79.7	52.1	130.6	4.35	29 95
October	59.6	44,9	65.0	1st	34.0	2nd	41.3	29.0	2nd	2.21	16	0.41	22nd	52.9	53.7	51.9	1.5	90.6	48.9	80.6	2.60	29.90
November	49.0	35.6	59.0	3rd	27.0	20th	31.0	22.0	25th, 26th	1.42	14	0,29	12th	45.6	47.4	42.3	1.4	88.9	39.1	70.7	2.36	29 96
December	43 0	32.6	50.0	18th	24.0	13th, 14th	28.2	18.0	13th	1.40	9	0.72	18th	40.6	42.4	36.9	0.9	91.7	34.6	47.7	1.54	30.09

Total rain for year, 21.11 ins. No. of days precipitation, 144. Total bright sunshine for year, 1555.6 hours.

DIAGRAM SHEWING ARRANGEMENT OF EXPERIMENTAL PLOTS, 1943